Urenco Pre-Application Meeting
Date: March 19, 2002

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Wayne Burnside	NRC Security	301-415-2211
Margaret Chatterton	NRC/NMSS/FCSS/FSPB	301-415-7906

Urenco Pre-Application Meeting
Date: March 19, 2002

NAME	AFFILIATION	PHONE
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Jim Hammelman	SAIC	540 341-8002
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Urenco Pre-Application Meeting
Date: March 19, 2002

NAME	AFFILIATION	PHONE
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Urenco Pre-Application Meeting Agenda
March 19, 2002

1:00 PM	Purpose/Introductions (TCJohnson)
1:15 PM	General Description/Process (Urenco)
1:45 PM	Differences Between Proposed Design and Louisiana Energy Services Design (Urenco)
2:00 PM	Gas Centrifuge Safety Issues (Urenco)
3:00 PM	General Approach to Licensing (Urenco)
3:30 PM	Future Issues and Topics for Pre-Application Review (Urenco)
4:00 PM	Prioritization of Meeting Topics and Schedule of Pre-Application Review Meetings (Urenco, NRC)

Louisiana Energy Services (LES)
Presentation to NRC

On March 19, 2002

in

Rockville, Maryland

Agenda

1.15	Introduction to Urenco / LES	(P C Upson, Urenco)
1.45	General Description of the Plant / Processes	(D L Wild, Urenco)
2.15	Differences between Proposed Design and Original Louisiana Energy Services Design	(C A Andrews, Urenco)
2.45	General Approach to Licensing	(R Krich, Exelon)
3.15	Future Issues and Topics for Pre-Application Review	(R Krich, Exelon)
3.45	Prioritizations of Meeting Topics and Schedule of Pre-Application Review Meetings	(R Krich, Exelon)

Participants

Pat Upson (Managing Director, Technical, Urenco Ltd.)

Duncan Wild (Head of Urenco Project Division, UPD)

Chris Andrews (Design & Licensing Manager, UPD)

Rod Krich (Interim Licensing Consultant to LES, Exelon)

Introduction : Motivation & Aims

Motivation - **market requirement and strategic need for US based capacity**

- **LES wish to supply US market**

Aims

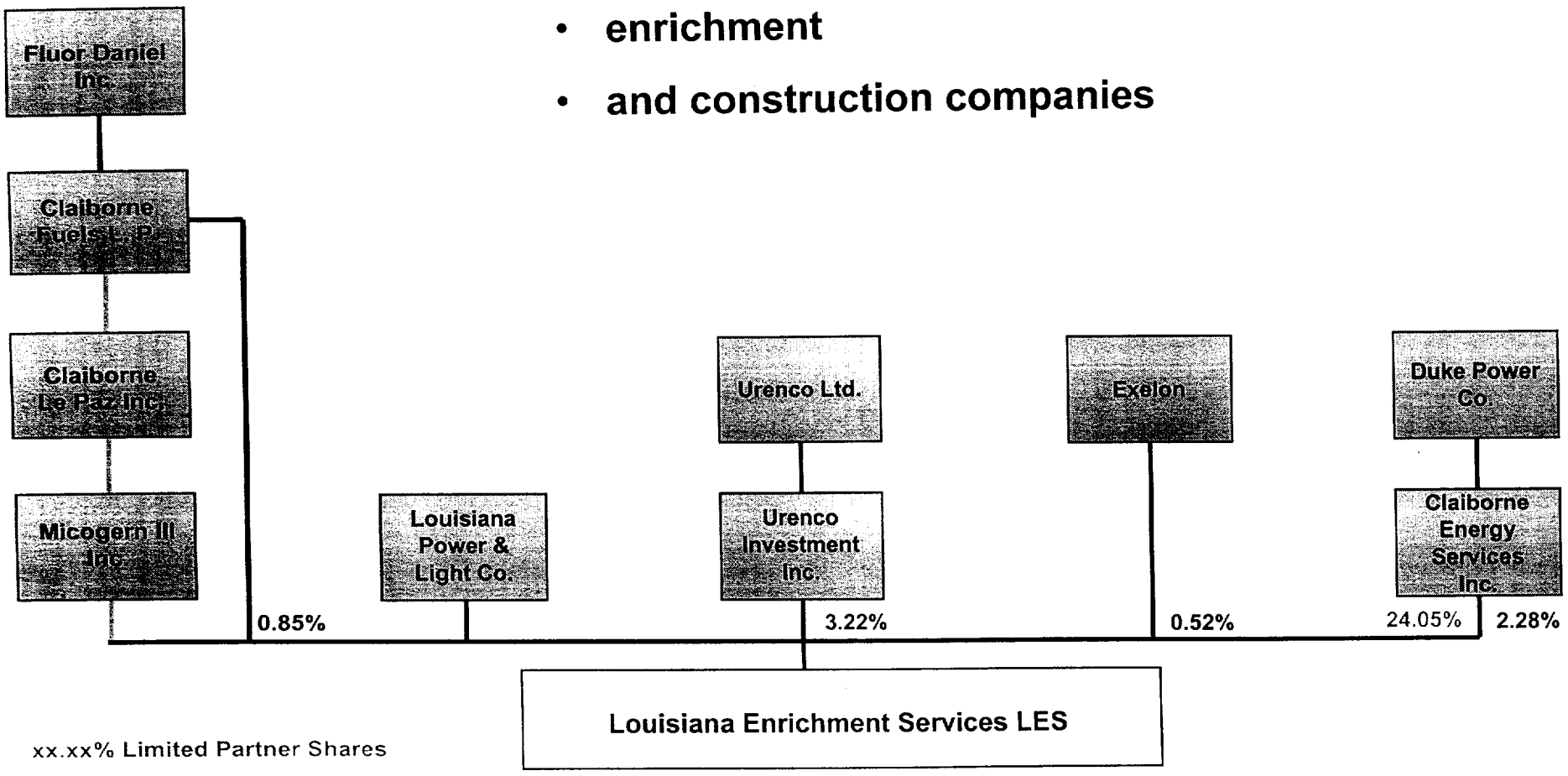
- **to introduce latest, most cost efficient and reliable Urenco technology into the US**
- **to start producing in 2007**
- **to install production capacity of at least 3,000,000 SWU/yr to meet market demand**
- **to react to market needs by adapting the installation programme as required**

LES

Who are LES ?

Partnership of

- **utilities,**
- **enrichment**
- **and construction companies**



xx.xx% Limited Partner Shares

xx.xx% General Partner Shares

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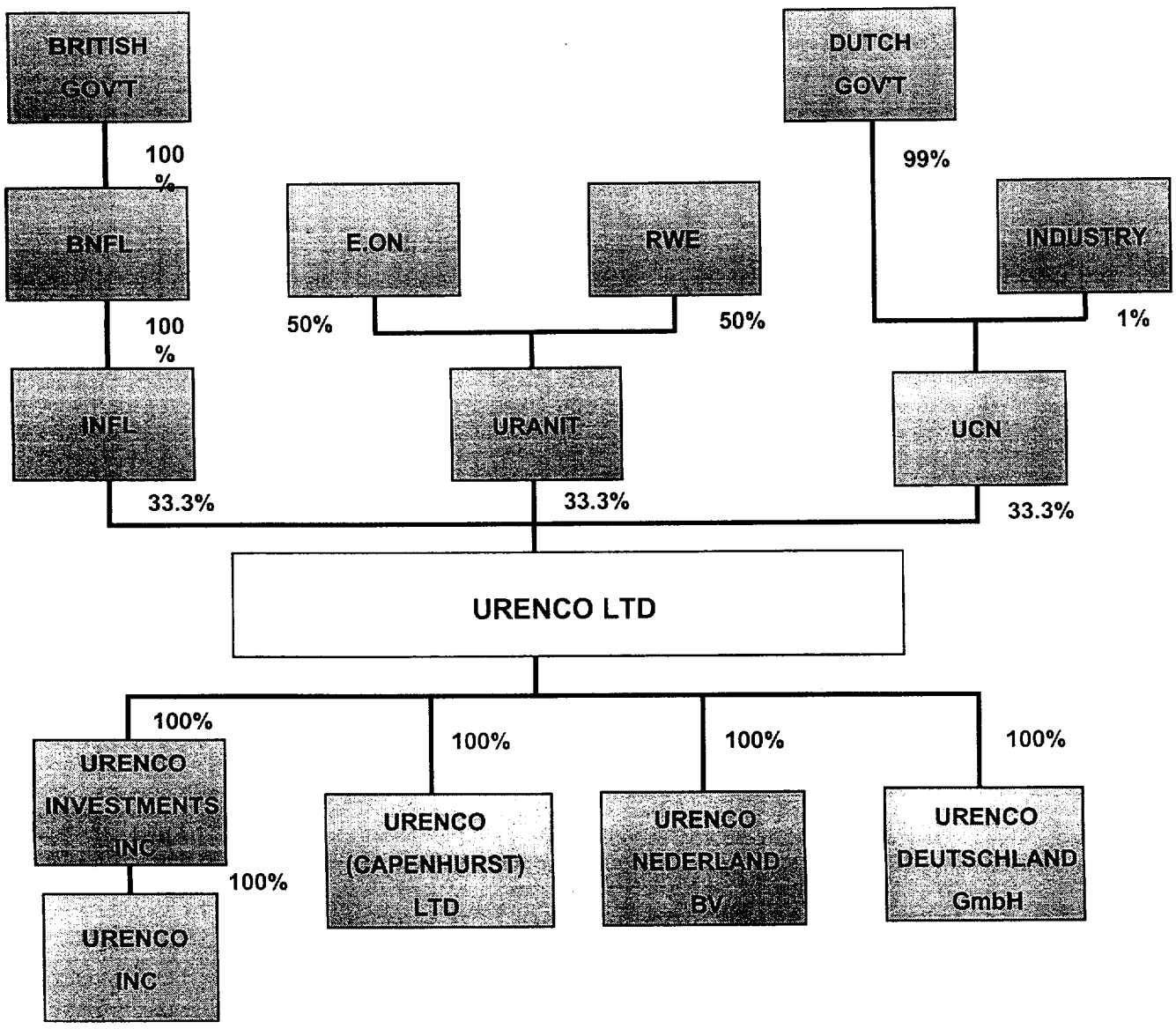
The Urenco Structure



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Urenco : Facts and Figures

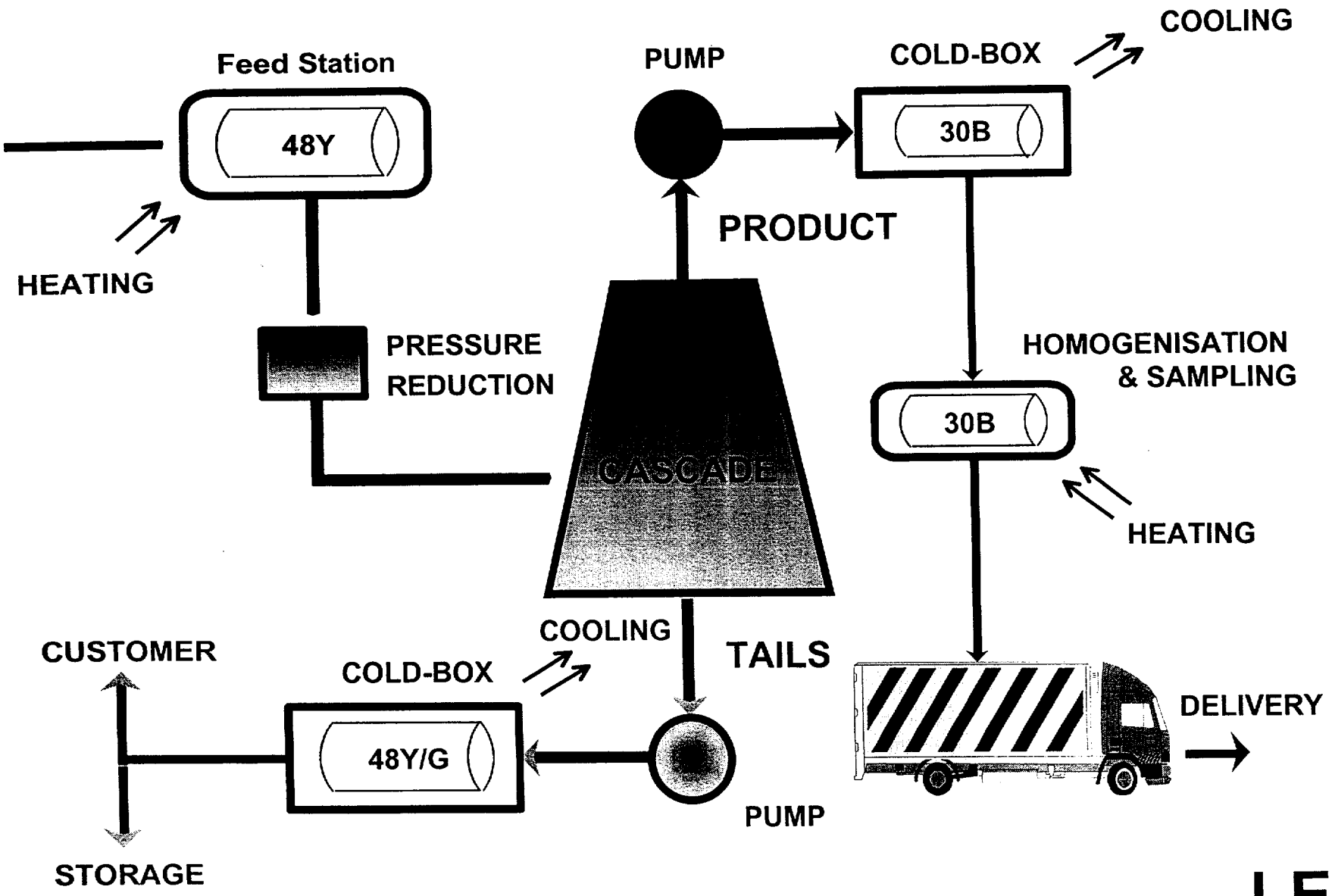
- **Formed by the Treaty of Almelo in 1970**
- **Enrichment plants in Germany, Holland and the UK**
- **Government shareholders in Holland and the UK, leading industry shareholders in Germany**
- **World leaders in the centrifuge enrichment process**
- **Steady rise in production from 1976**
- **Approaching 15% world market share**
- **Significant supplier to Western Europe, US and Asia**
- **Ongoing plant installation programme, construction of 3 million SWU new plant since 1995**
- **Revenues of M€ 470 (≈ $ 423M) in 2001**
- **Large future order book**

LES

Historical Survey of Centrifuge Technology

1945	**First gas centrifuges developed**
1966	**First centrifuge prototypes developed**
1970	**Almelo Treaty**
1972	**First pilot cascades in the UK and Netherlands on line**
1976	**First commercial cascade on line**
1981	**First cascades with improved machines**
1986	**Cascades with more improved machines**
1988	**First cascade with carbon fibre reinforced plastic rotor**

Centrifuge Production Flow Diagram



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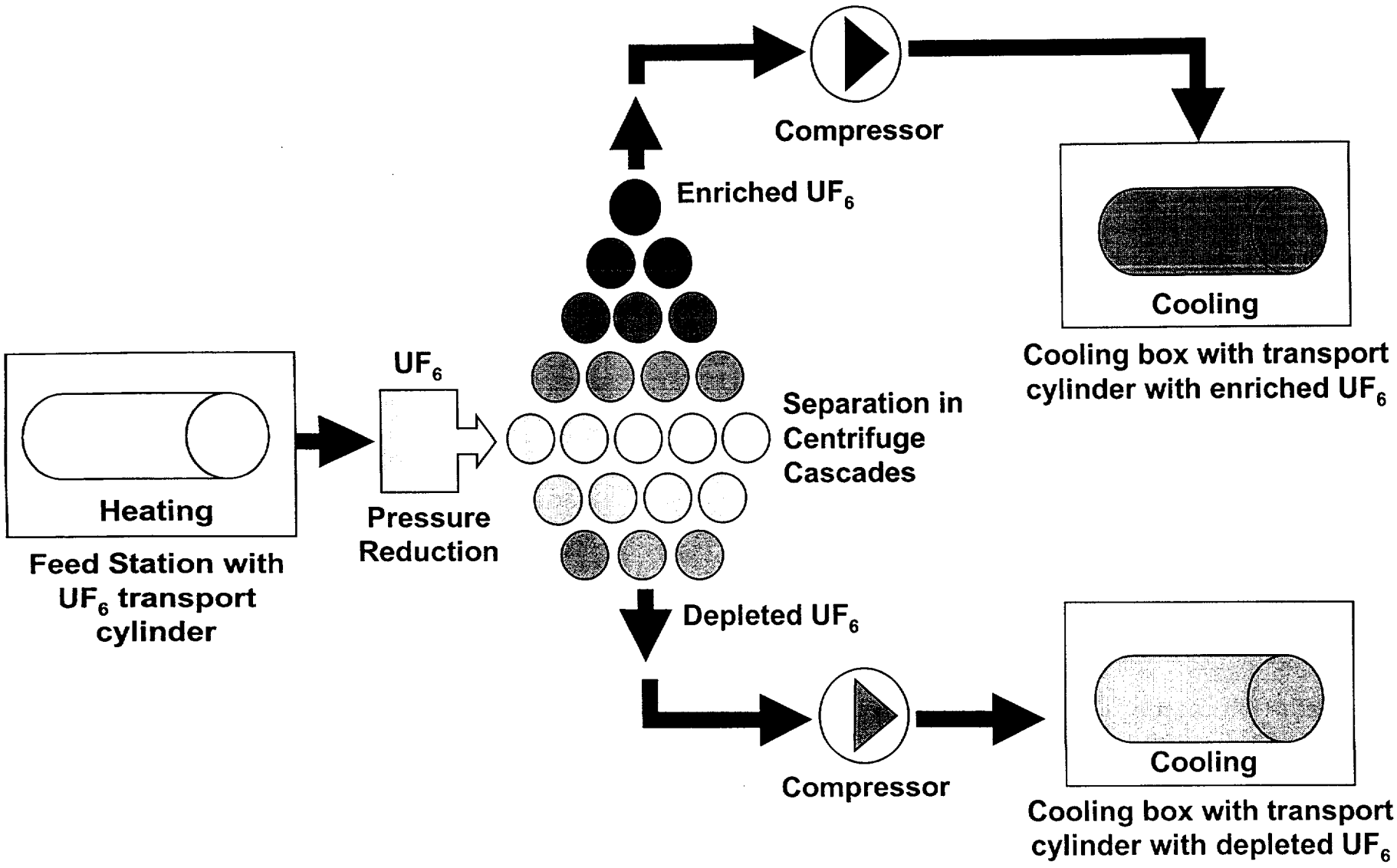
Flow of UF_6 through the Enrichment Plant



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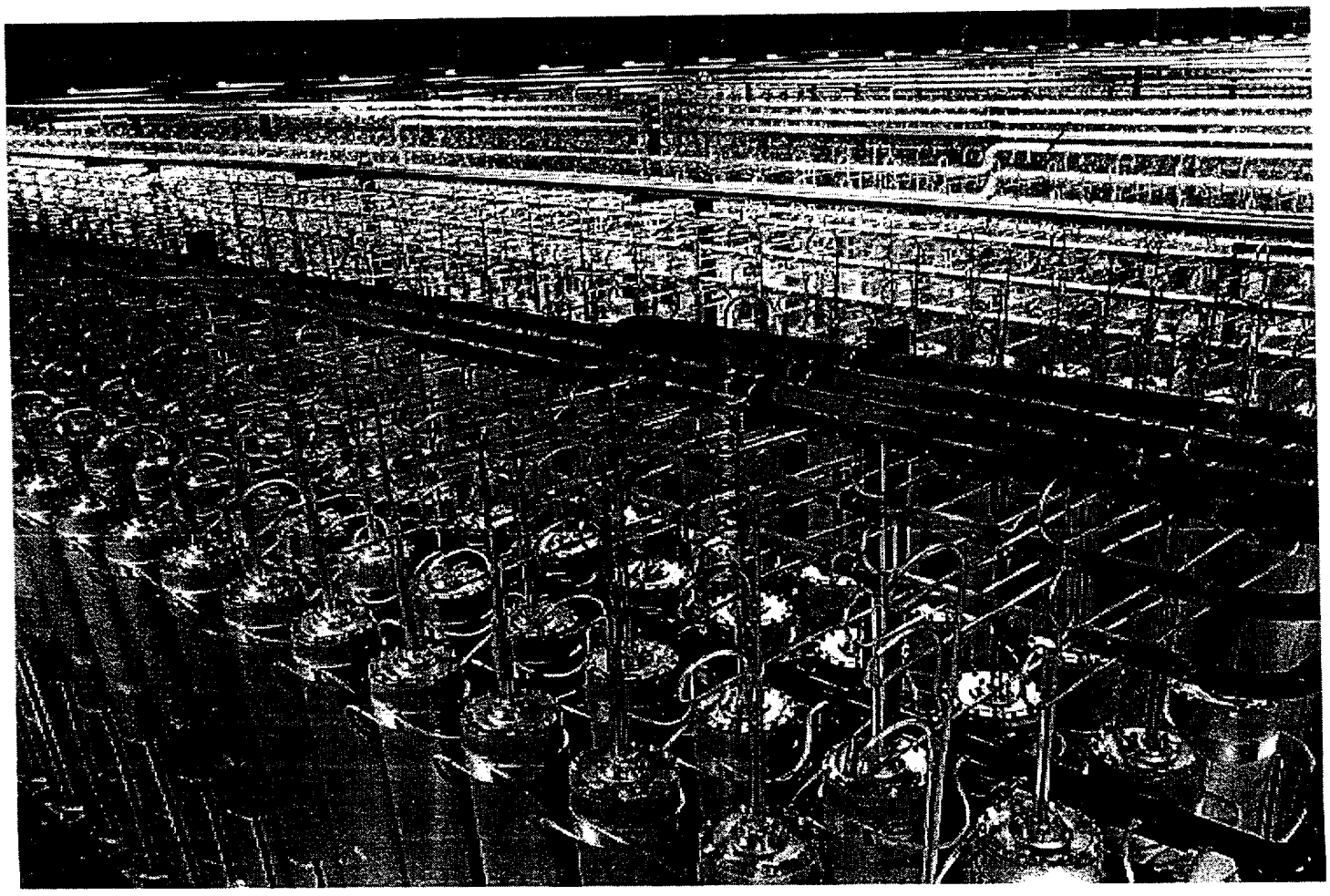
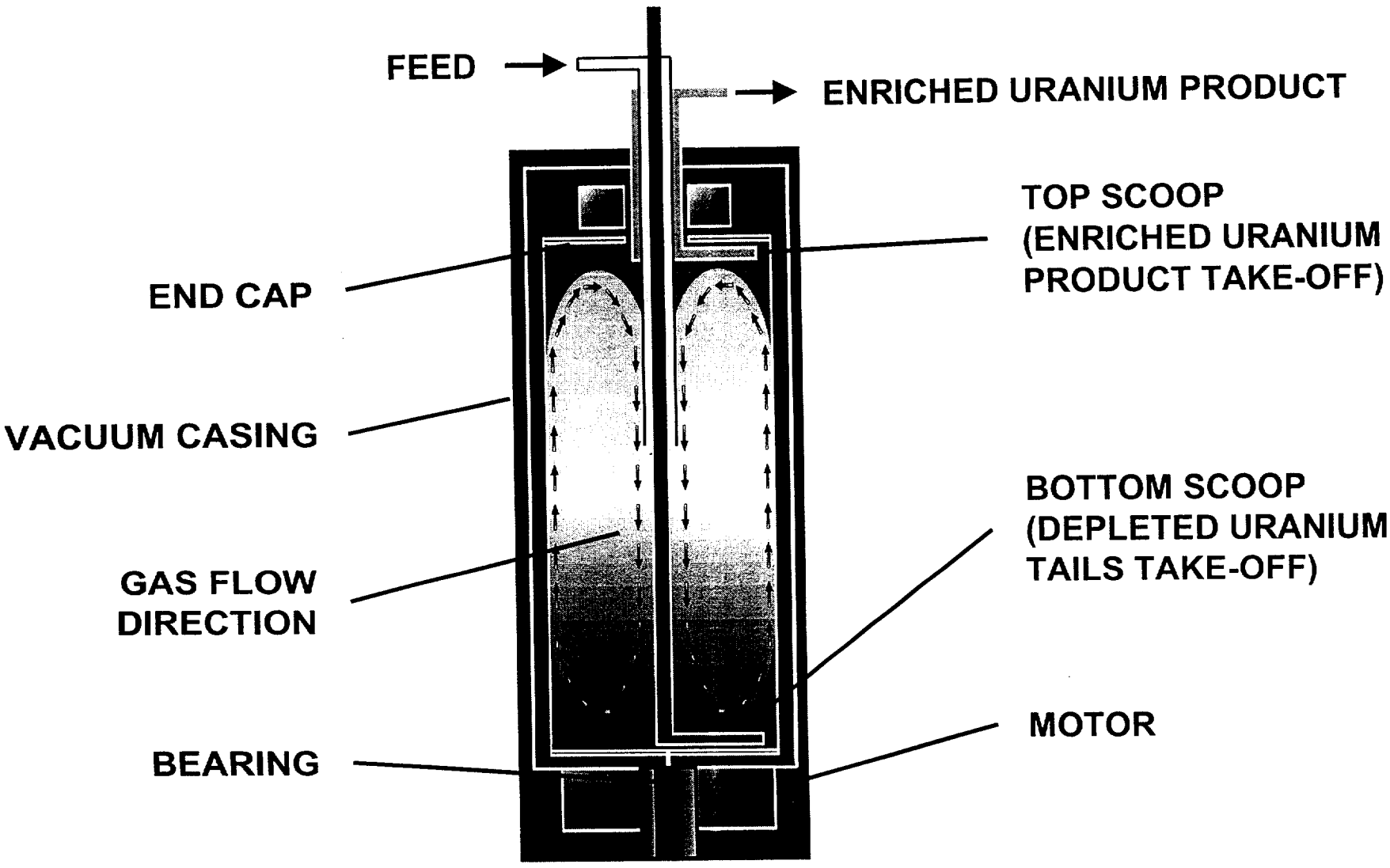
A Centrifuge Cascade



How The Ultracentrifuge Works



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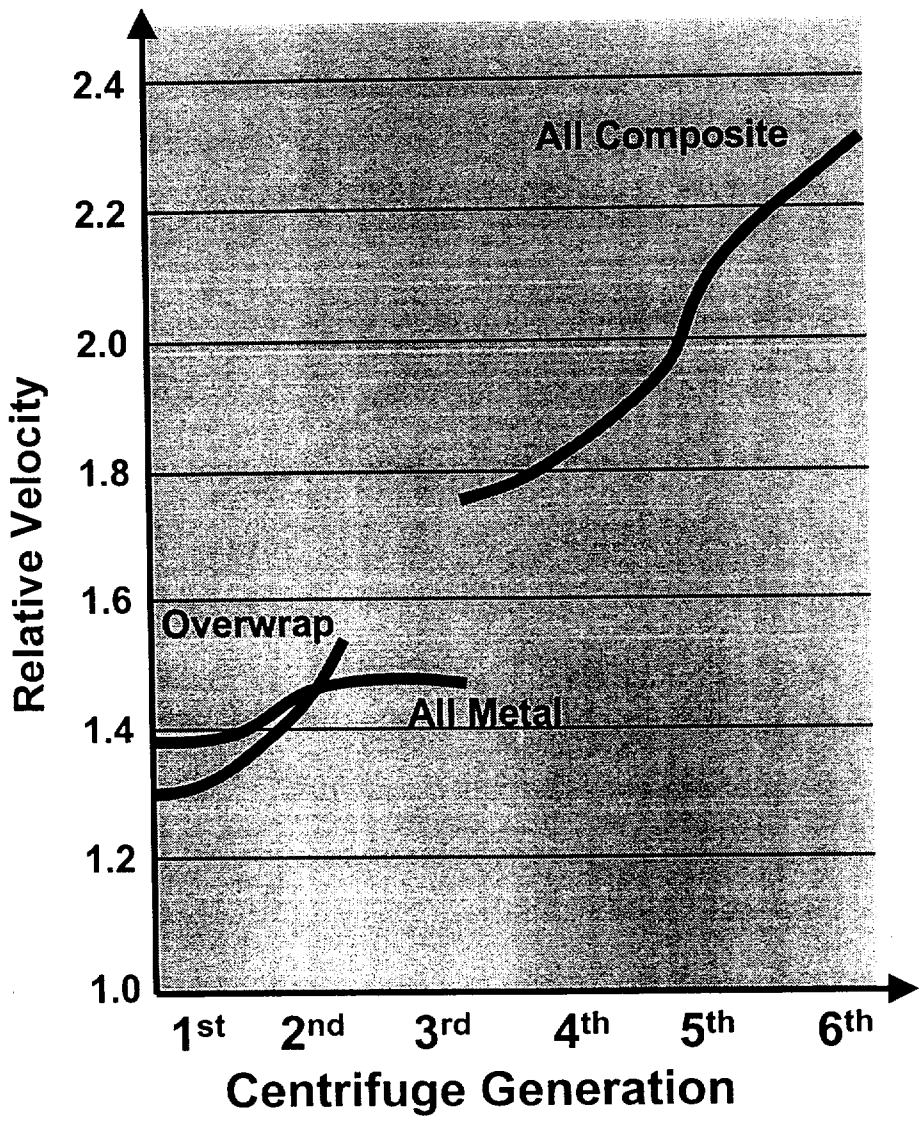
Urenco's Centrifuge Design Philosophy

- **No maintenance or service**
- **Maximum reliability**
- **Low energy consumption**
- **Low investment costs**
- **High efficiency**



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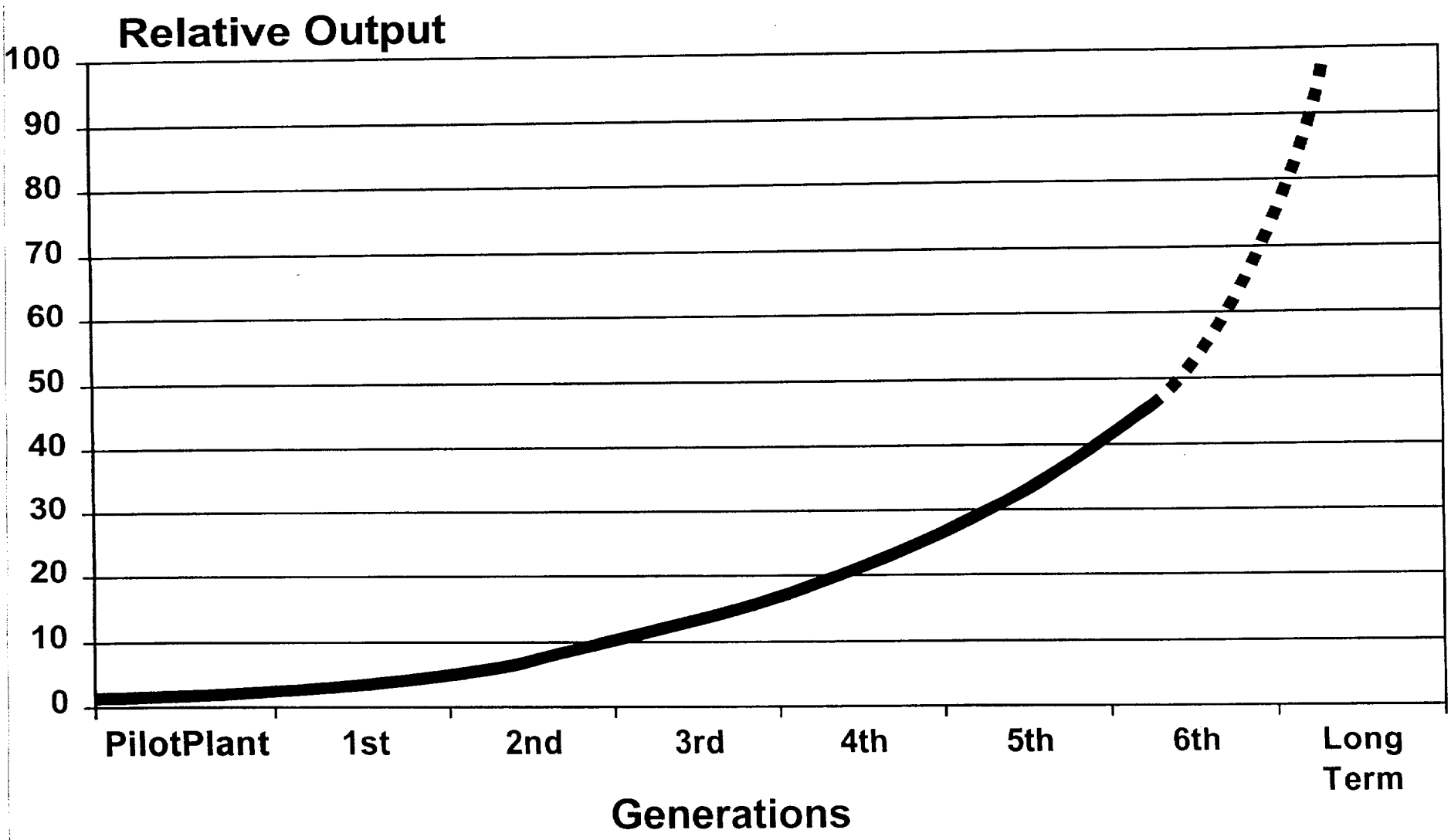
Urenco Centrifuge Development



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Urenco Centrifuge Development : Latest Design

Early Design

Latest Design

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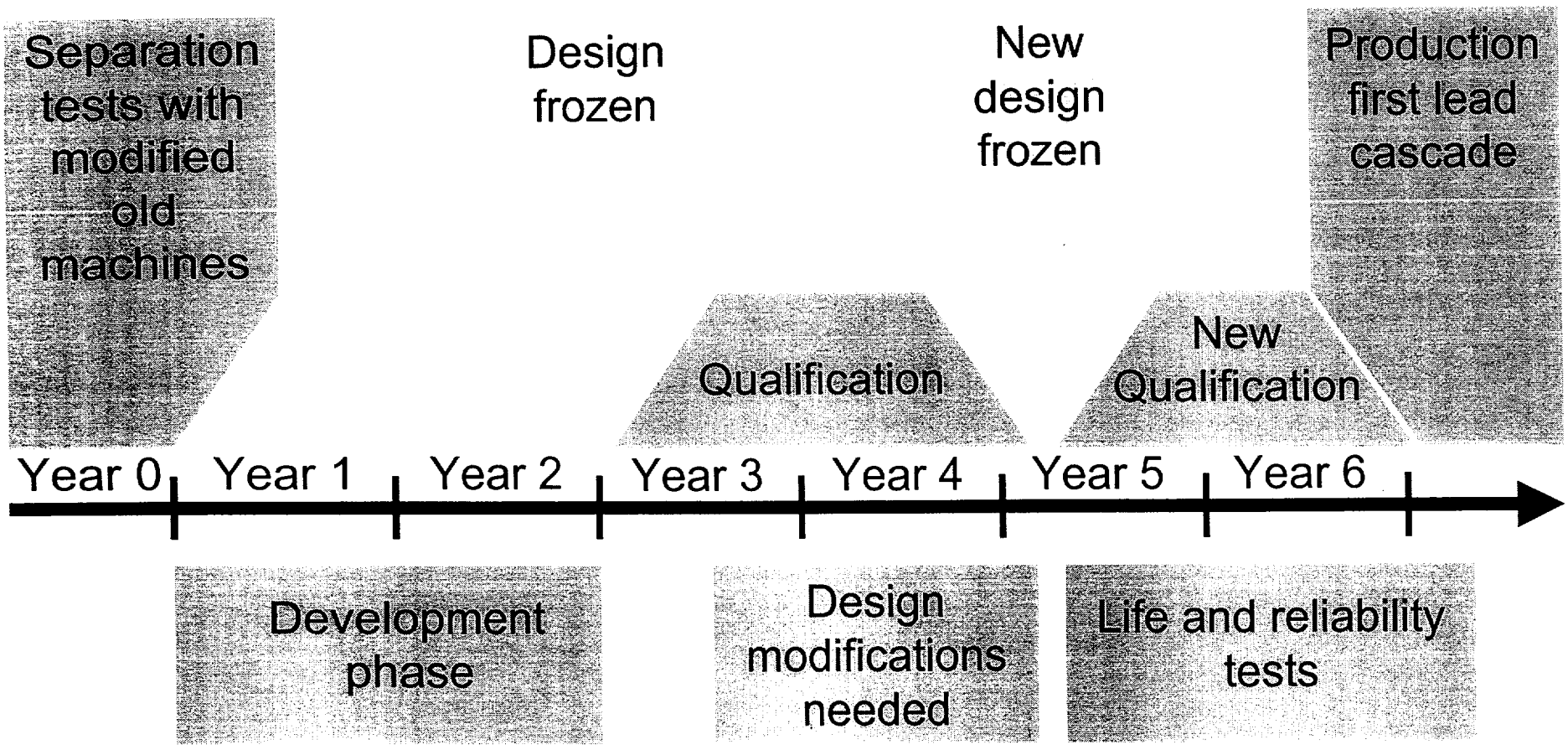
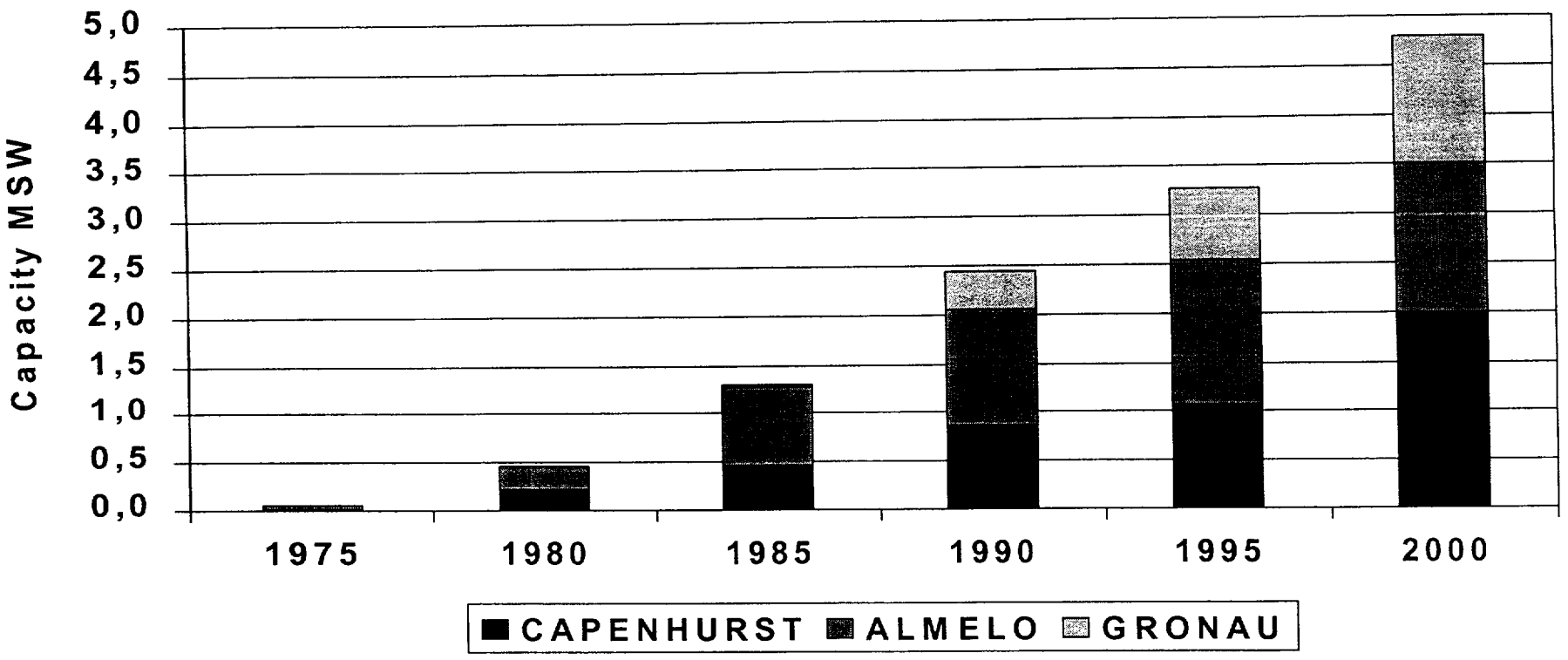
Typical Development Programme of a New Machine



Urenco Installed Centrifuge Capacity



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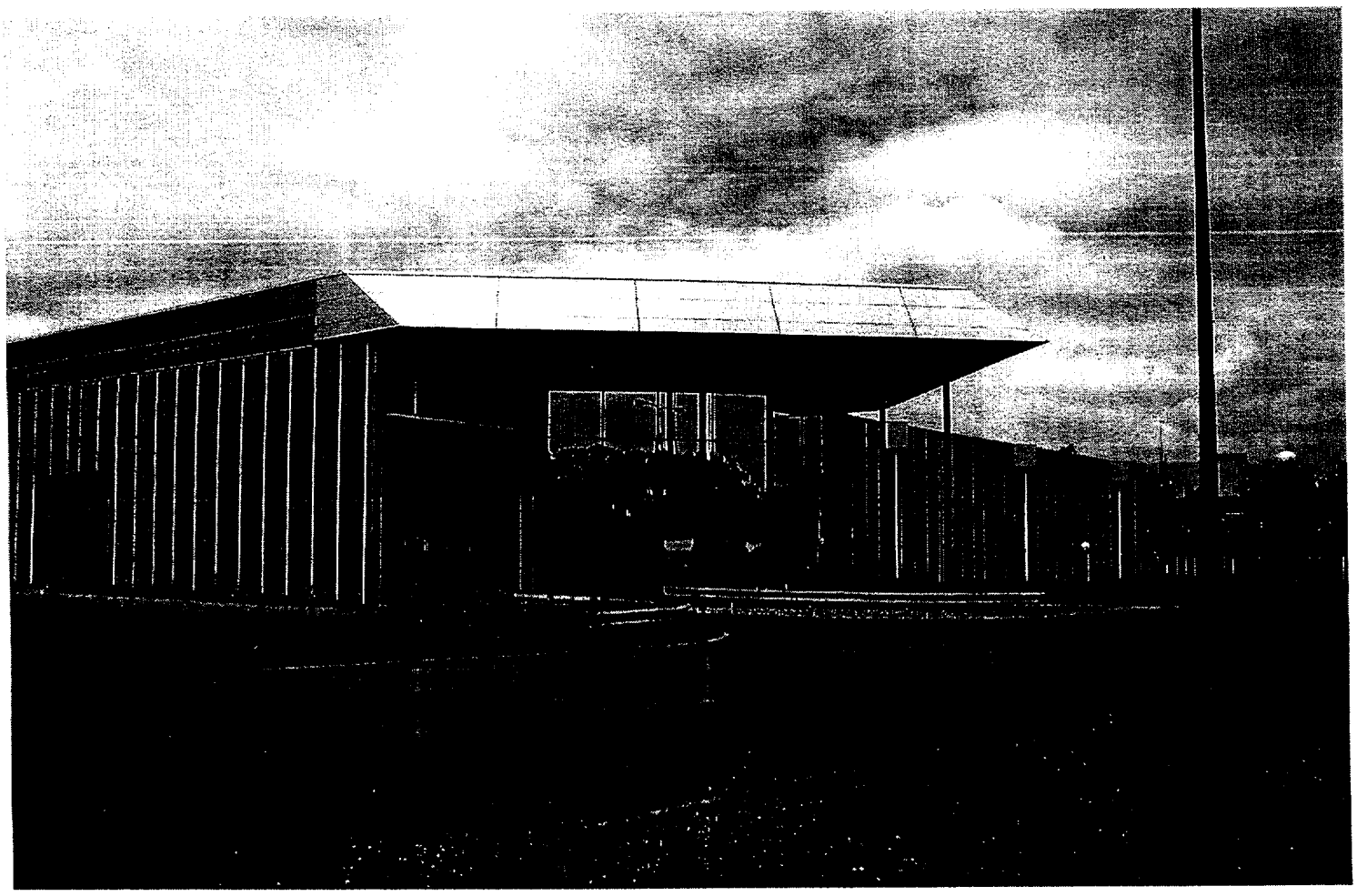
SP5 Building Almelo



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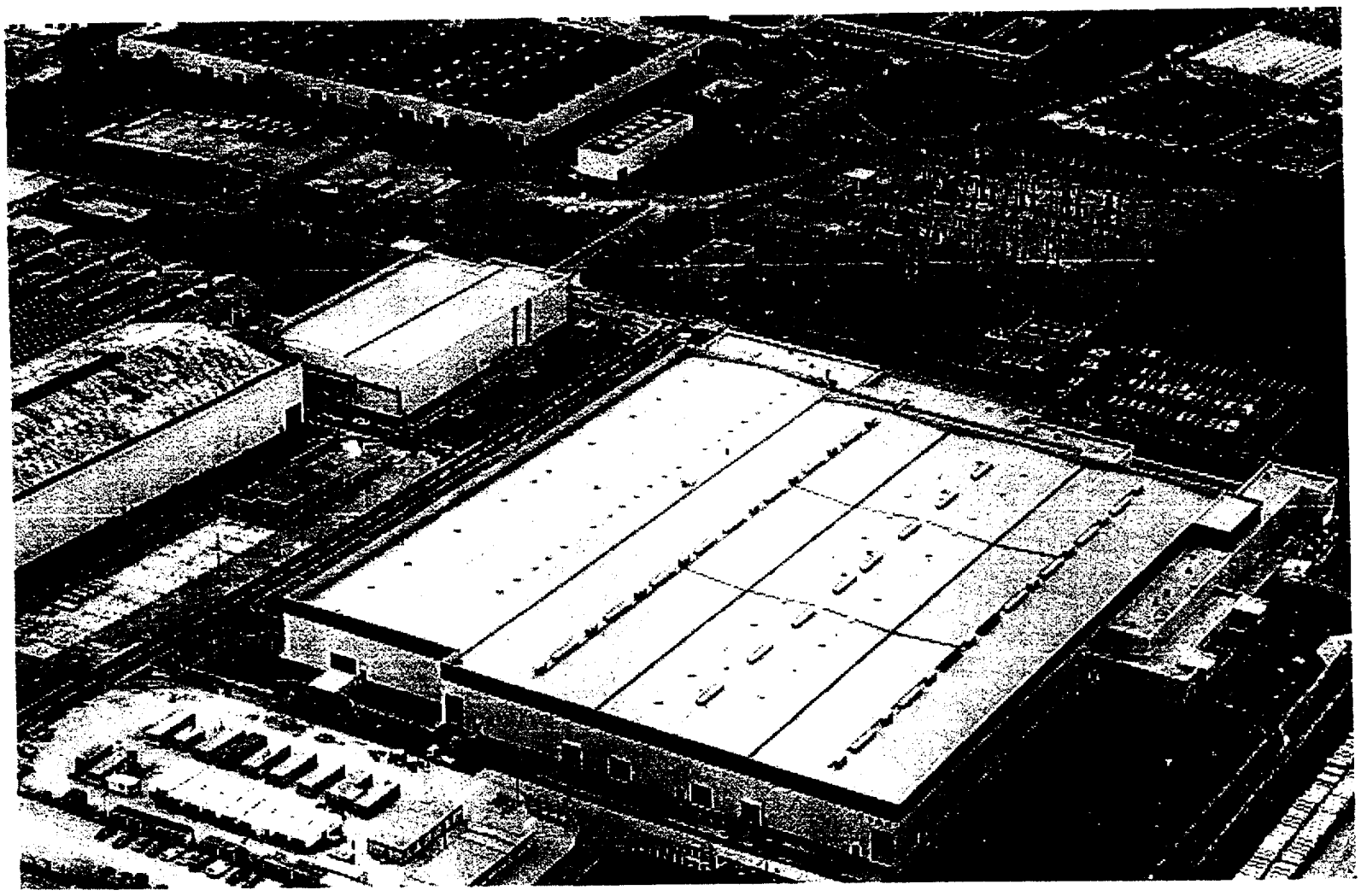
E23 Building Capenhurst



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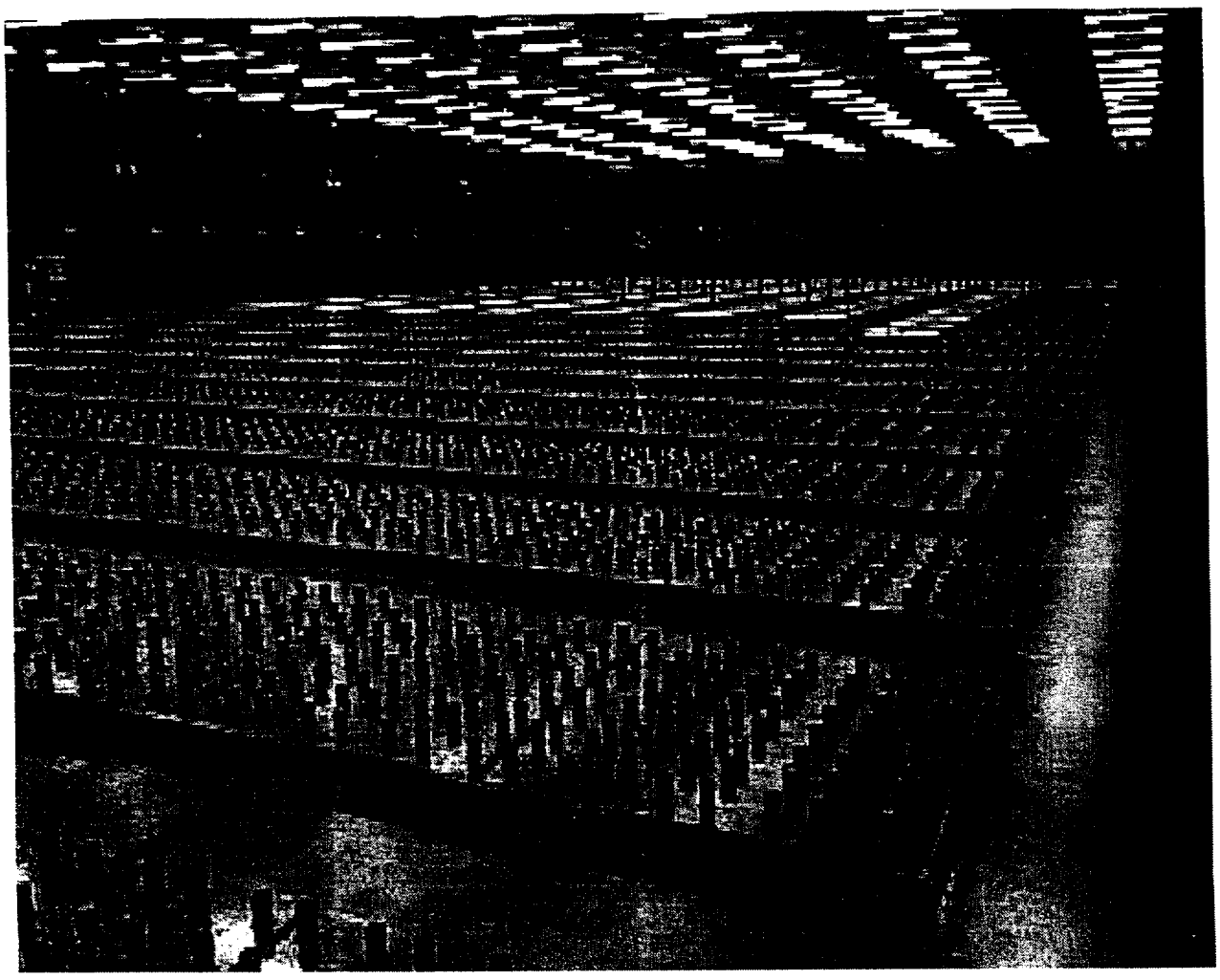
Cascade Build Up



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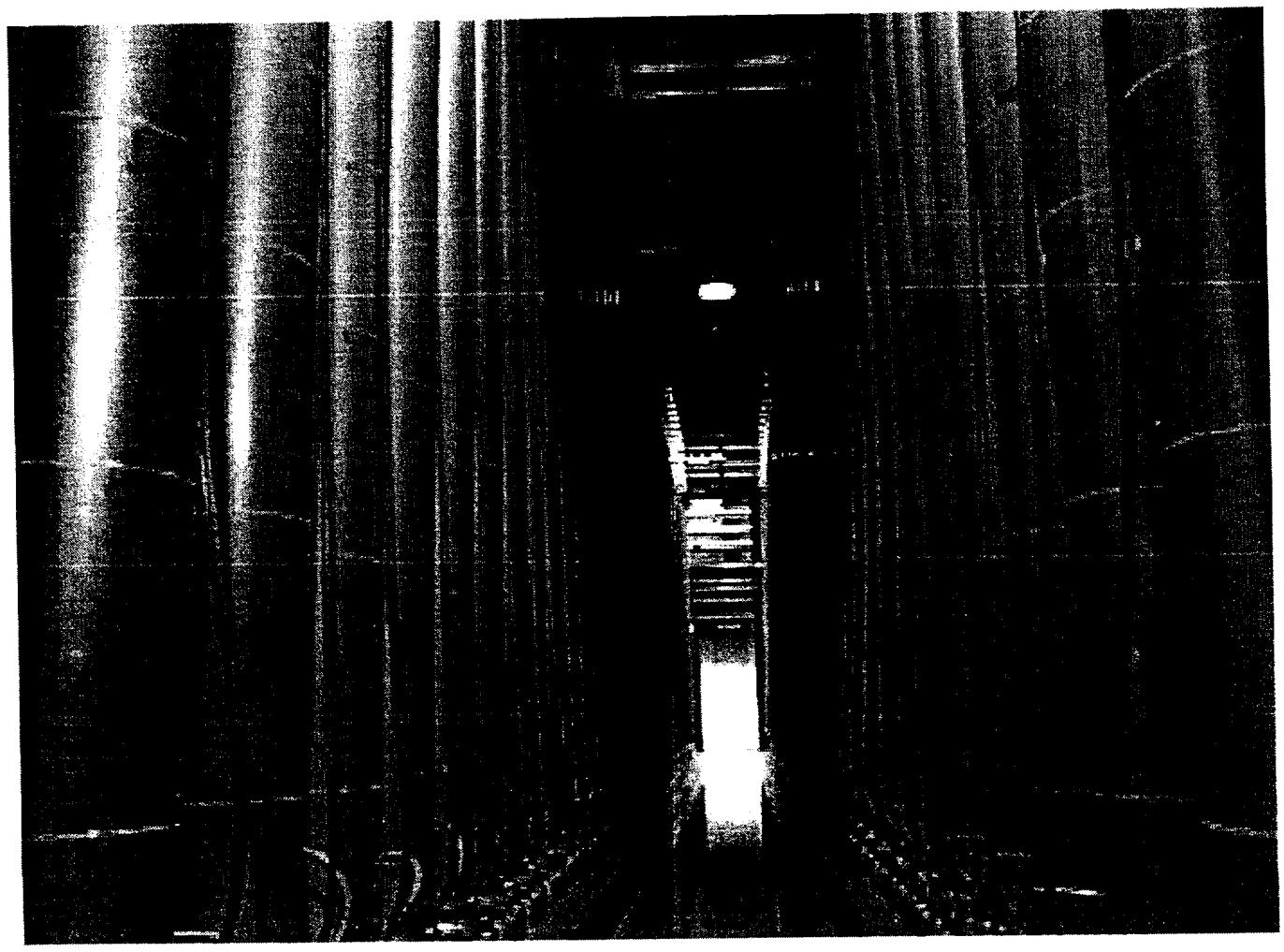
Filled Cascade



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Prerequisites for the Project

- **Assured Licensing Process**
  - **Short & Predictable**
- **Customer Commitment**
- **Access to US Tails Disposal Route**
- **Location on Existing Nuclear Site**
- **US Project / Engineering Expertise**
- **Nuclear Site Operating Expertise**

Enrichment Plant Timeline - 1

Pre Application Review	**Starting March 19, 2002**
Site Selection	**Q2 2002**
License Application Submitted / Environmental Report Submission	**Q4 2002**
Request License Approval	**Q2/3 2004**
Start on Site	**Q3/4 2004**
Building Complete	**End 2005**
1st Cascade On Line	**End 2006**
1 MSWU/yr Capacity On Line	**2007/2008**
Build up	**0.6 MSWU/yr**

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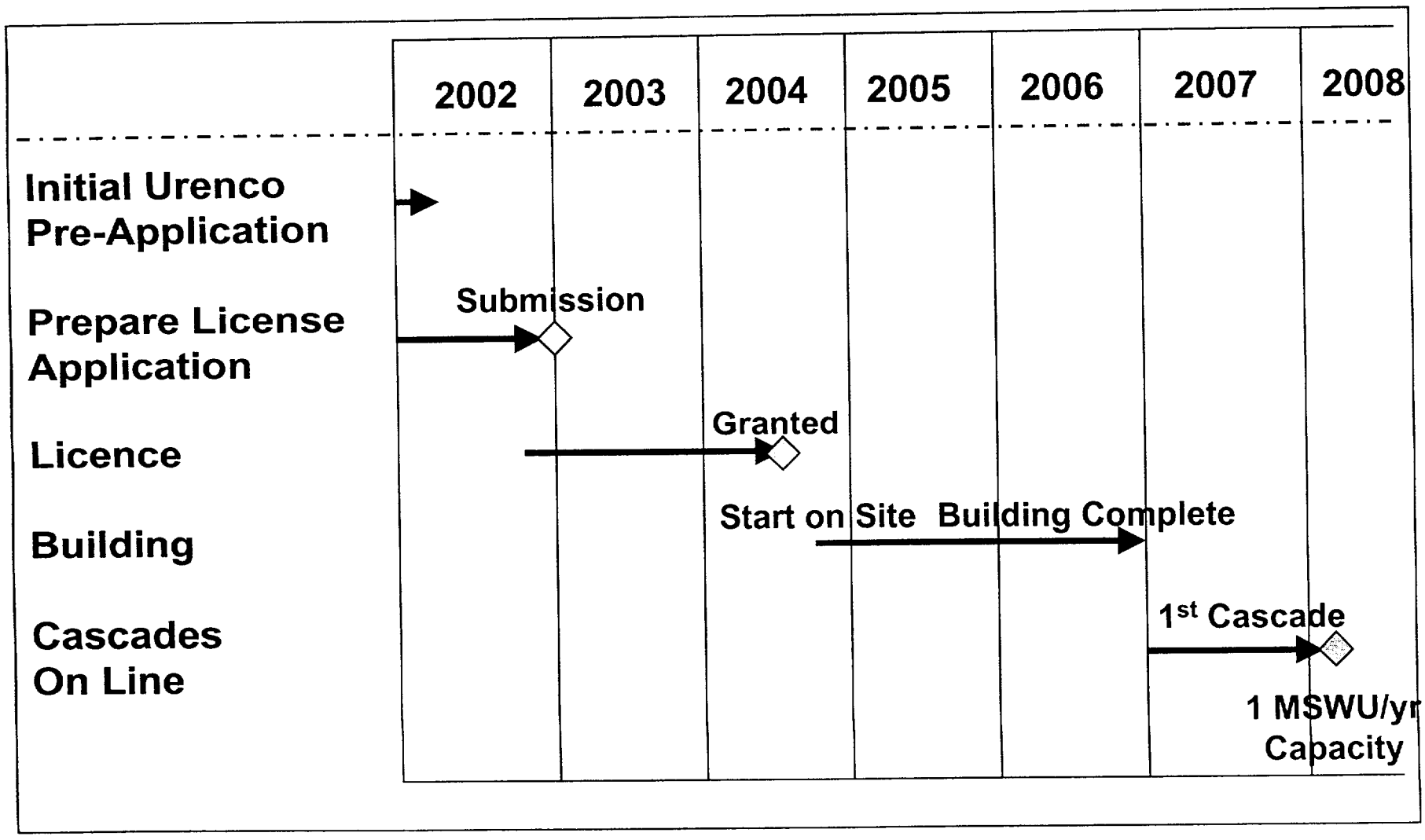
Enrichment Plant Timeline - 2



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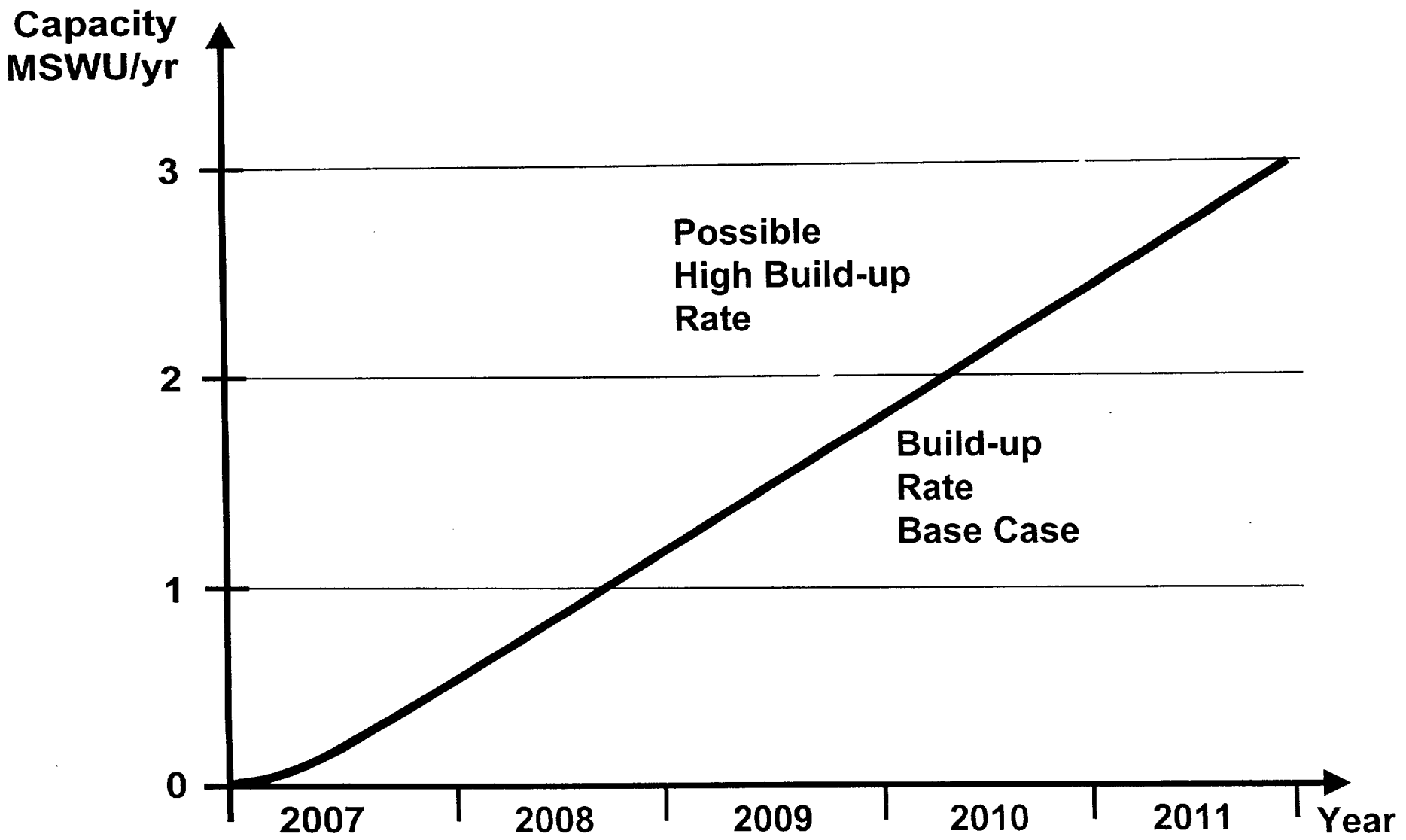
LES Capacity Build Up



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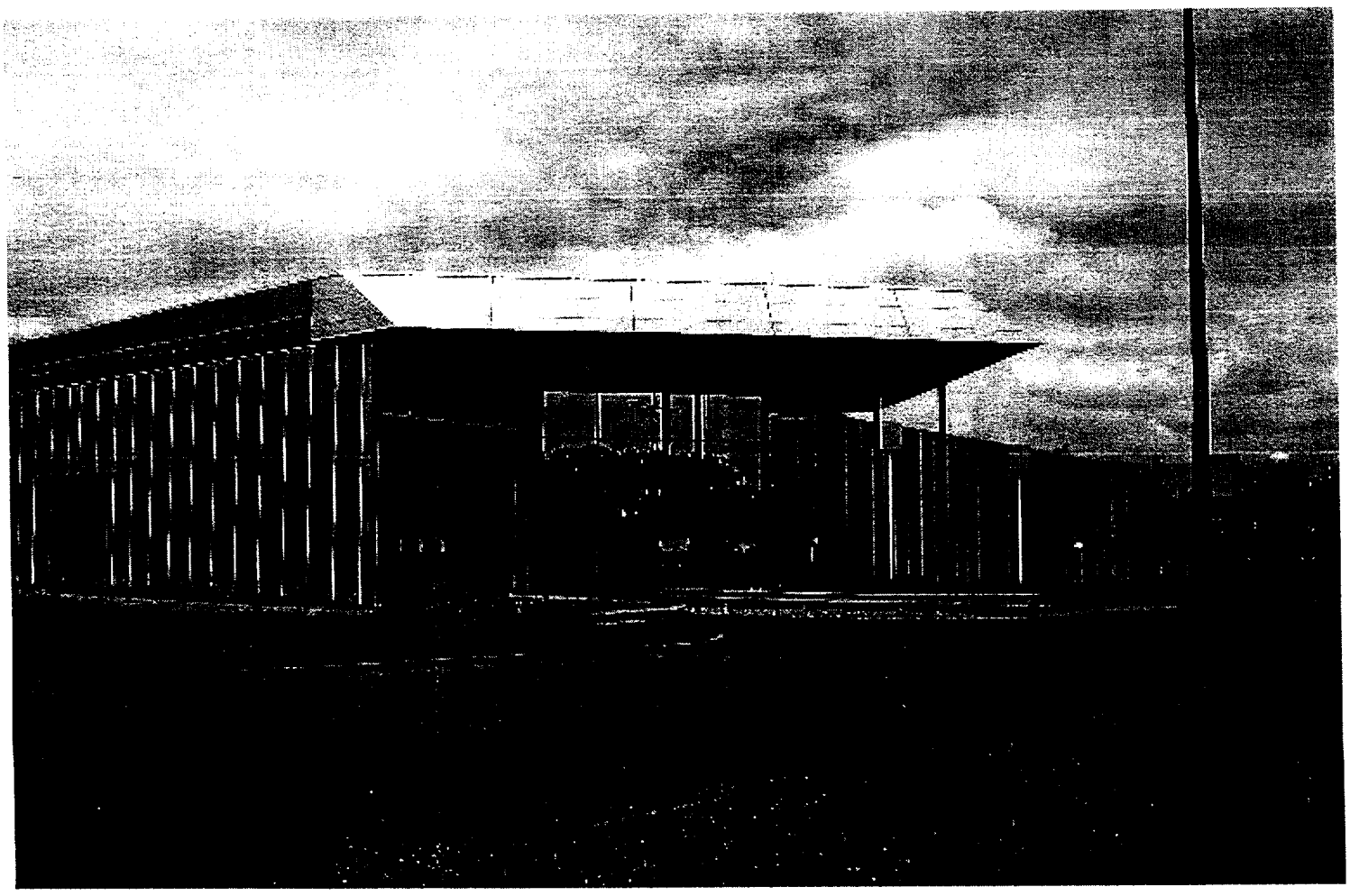
Overview of the proposed LES Centrifuge Based Uranium Enrichment Facility



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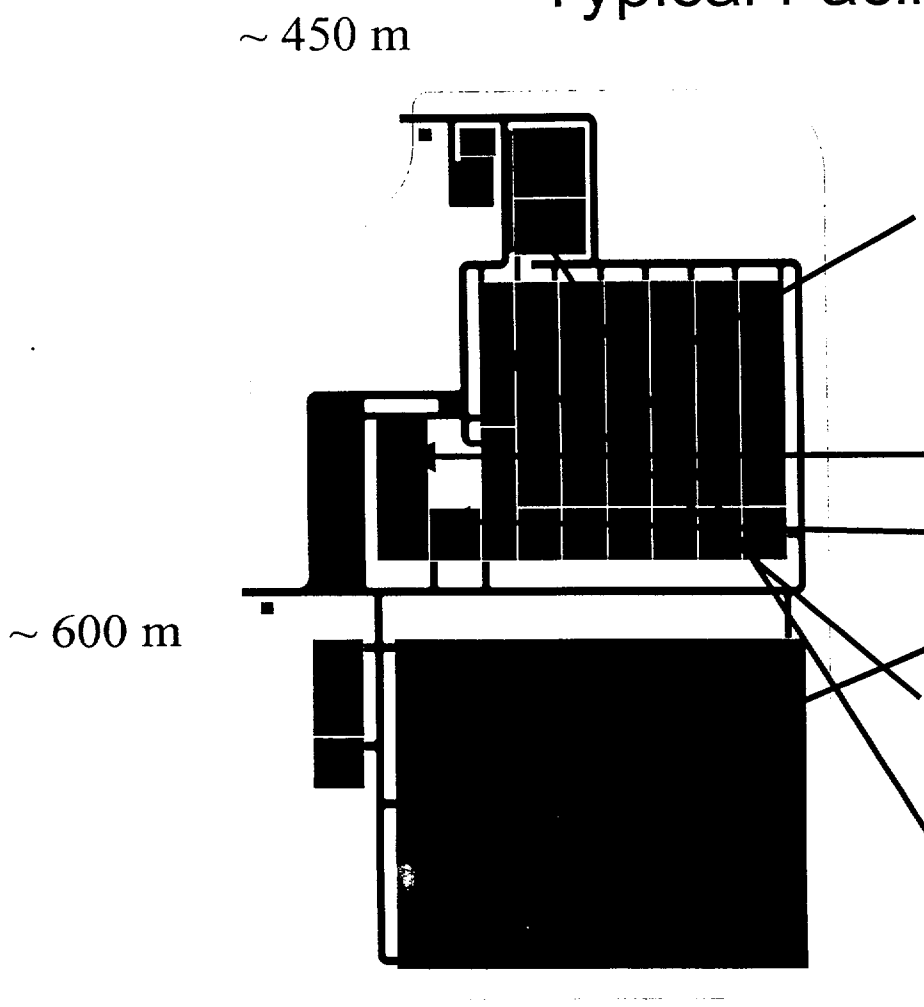
3000000 SWU/YR URANIUM ENRICHMENT FACILITY

Typical Facility Footprint



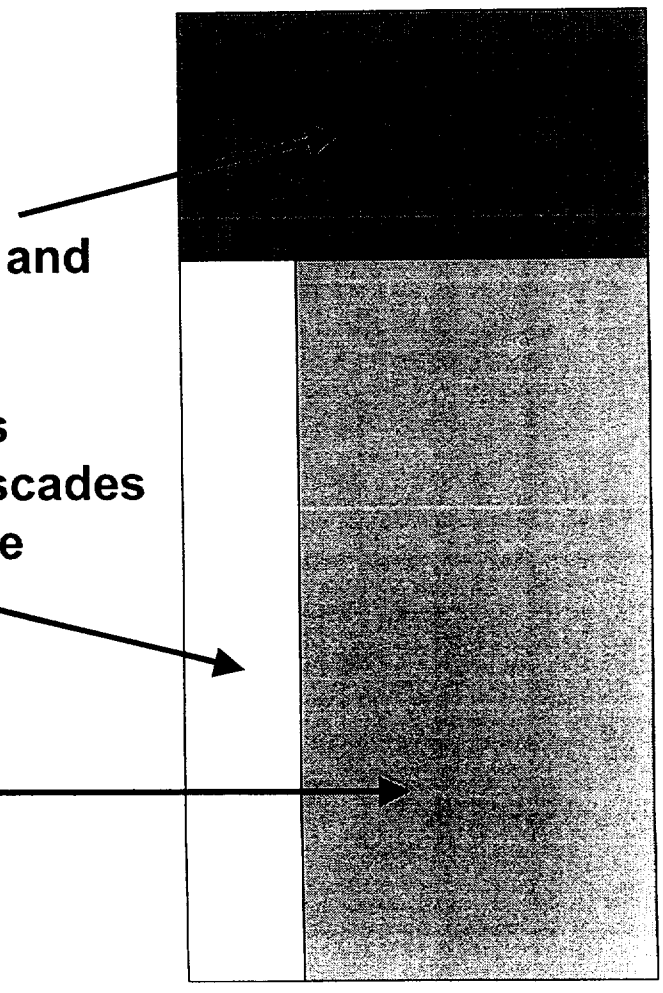
Comprises:

- Enrichment Plant
  - Separation Modules, Plant Services
- Operational Services
  - Cylinder Receipt / Dispatch
  - Blending & Sampling
  - Pads for Feed / Tails
- Technical Services
- Support Facilities
  - Centrifuge Assembly
  - Administration Building

LES

Enrichment Plant – 500000 SWU/yr Separation Module

- 3000000 SWU/yr Plant comprises six 500000 SWU/yr Separation Modules
- Each 500000 SWU/yr module comprises:
  - A UF_6 building containing the feed, product and tails take-off systems
  - A process services corridor housing the gas transport equipment which connects the cascades to the feed product and tails systems and the cascade evacuation systems
  - A Cascade Hall section which houses the separation system



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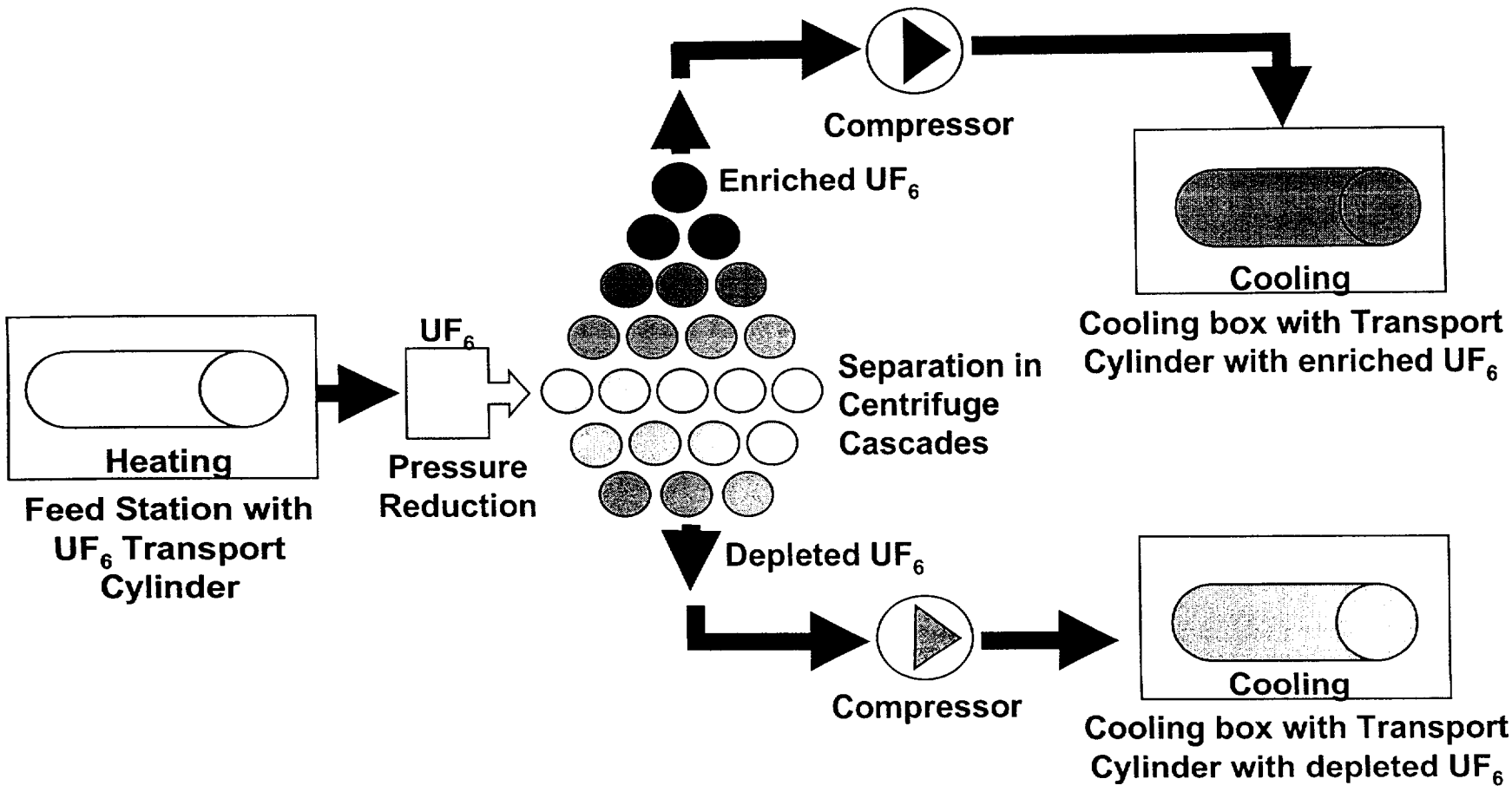
500000 SWU/yr Separation Module

The main UF_6 systems are illustrated below:-



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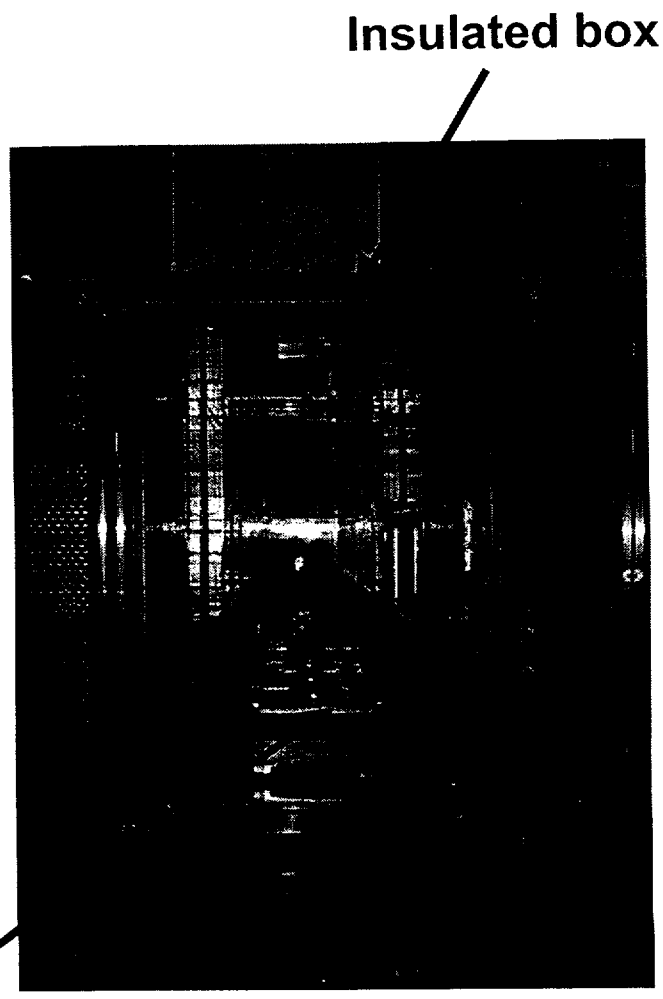
500000 SWU/yr Separation Module

Feed System

- Six electrically heated feed stations each housing a 48 inch cylinder with up to three on-line at any time
- Online weighing incorporated in stations
- Stations are side loading from rail transporter (as are all cylinder stations)

  No craning of cylinders
- Entire process is sub-atmospheric in solid and gaseous phases
- Pressure reduction step from feed cylinders to distribution manifold to cascades



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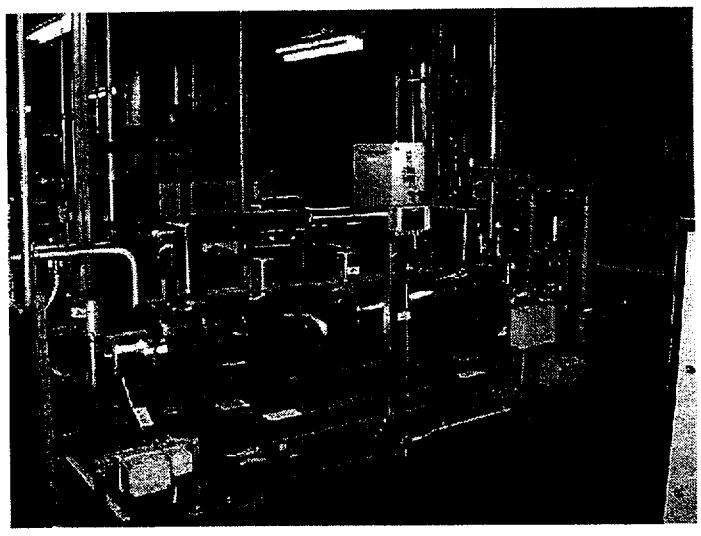
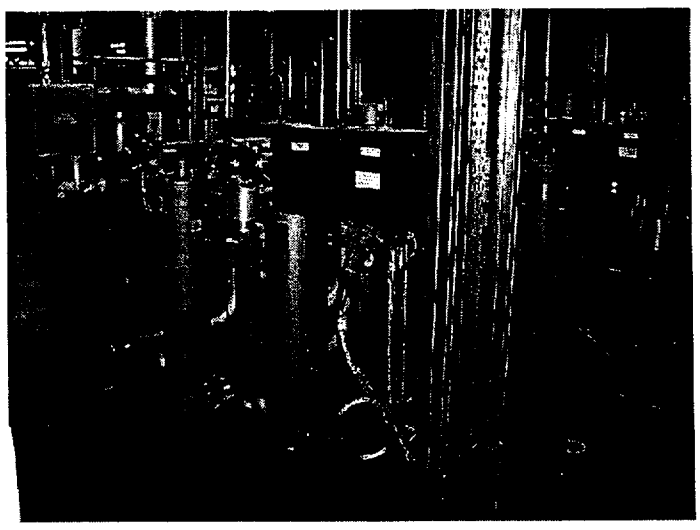
Separation Module

Feed Purification System

- Purpose is to remove ingressed air and HF from feed material prior to admittance to cascades, also to fully empty cylinders prior to disconnection

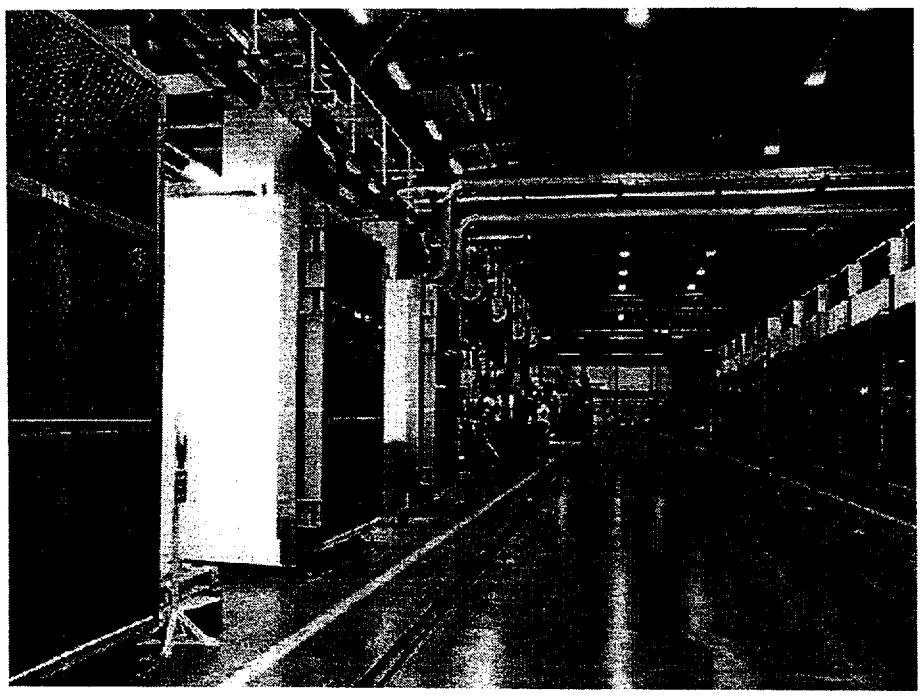
- Comprises :
  - two redundant air chilled 48 inch feed purification stations
  - two redundant UF_6 desublimers for light gas stream uranium separation
  - two redundant chemical trapping systems for light gas stream HF separation





Separation Module – Product Take Off System

- Six air chilled product take-off stations, up to three are on-line at any one time.
- Online weighing incorporated in stations.
- Stations are flexible and can accommodate either 30 or 48 inch cylinders.
- Low pressure compressors pump product flow from cascades into the six air chilled take off stations.



Separation Module

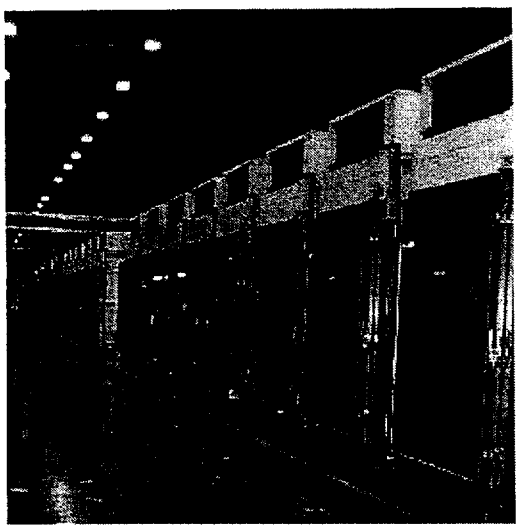
Product Vent System

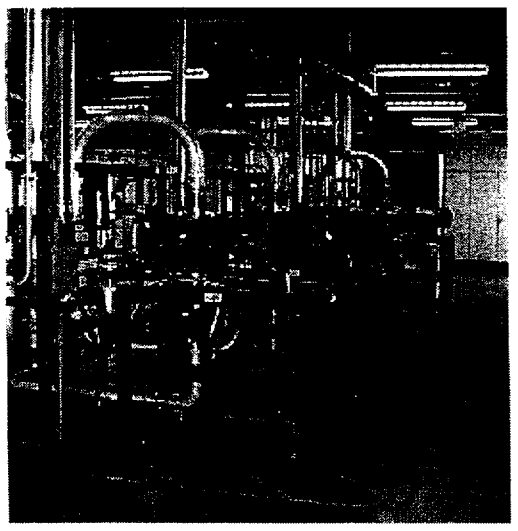
- Purpose is to remove entrained light gas, (air and HF) from the product flow.

- **Comprises:**
  - two redundant UF_6 desublimers for light gas stream uranium separation as feed purification.
  - two redundant chemical trapping systems for light gas stream HF separation.

Separation Module – Tails Take Off System

- Nine air chilled tails take-off stations, at least six are on-line at any one time
- Online weighing incorporated in stations
- Low pressure compressors pump tails flow from cascades to air chilled take-off stations

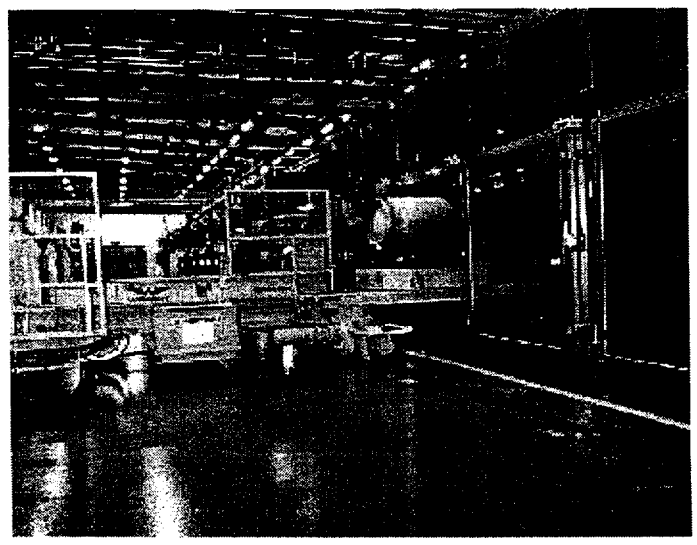




LES

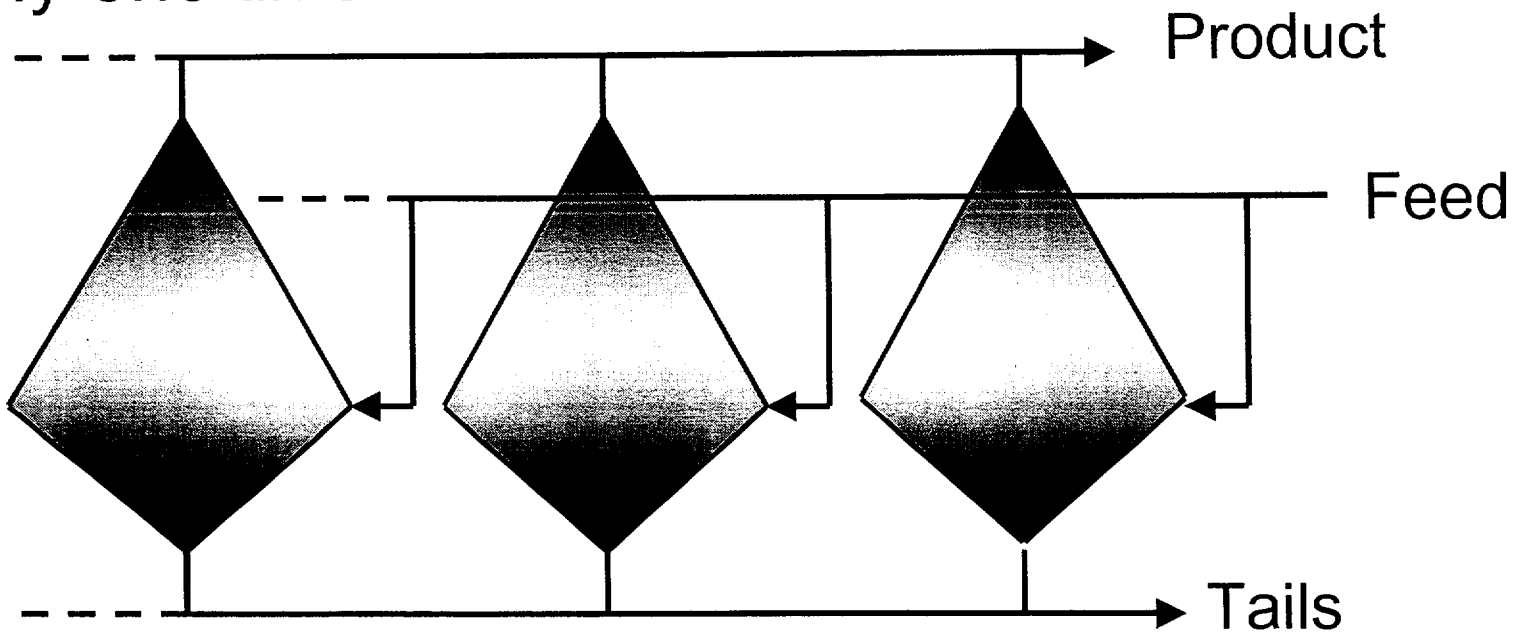
Separation Module – Cylinder Handling

- Rail Transporter for cylinder movements in UF_6 building
  - stations loaded from either side of rail track
  - draw bridge links transporter to station



Separation Module - Cascades

- The plant comprises six assay units, each assay unit consisting of a number of cascades connected in parallel producing a single product concentration at any one time.



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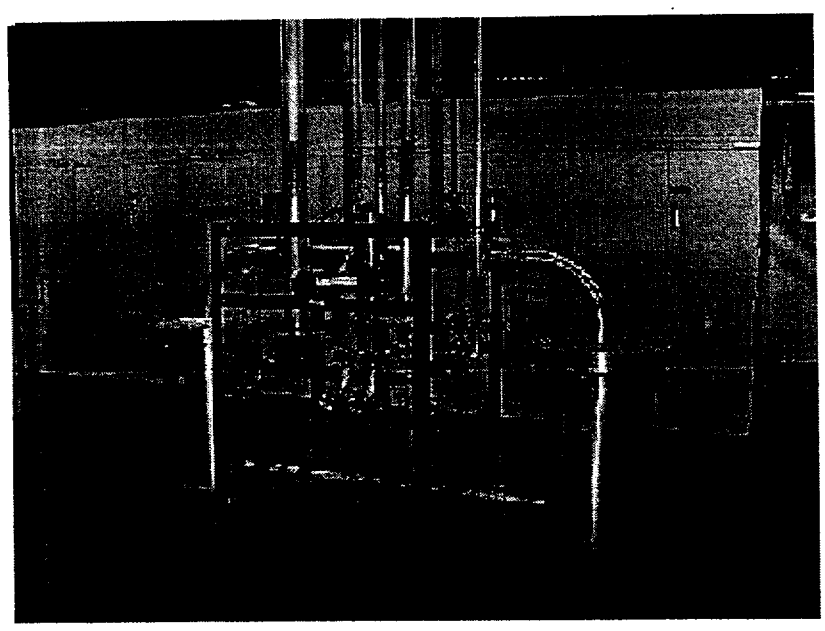
Separation Module - Cascades

- The centrifuges and cascade pipework are housed in the cascade hall. No routine access in required.

- All services to the centrifuges including drive, cascade control and cooling water are located in the process service corridor.

- A cascade specific UF_6 emptying system using chemical trapping (dump) is located in the process service corridor.



Operational Services

The Operational Services required in support of the receipt, storage and dispatch of cylinders are as follows:-

- Cylinder Receipt and Dispatch Building including Product Store
- Pads
- Blending and Transfer
- Liquid Sampling

Cylinder Receipt and Dispatch Building including Product Store

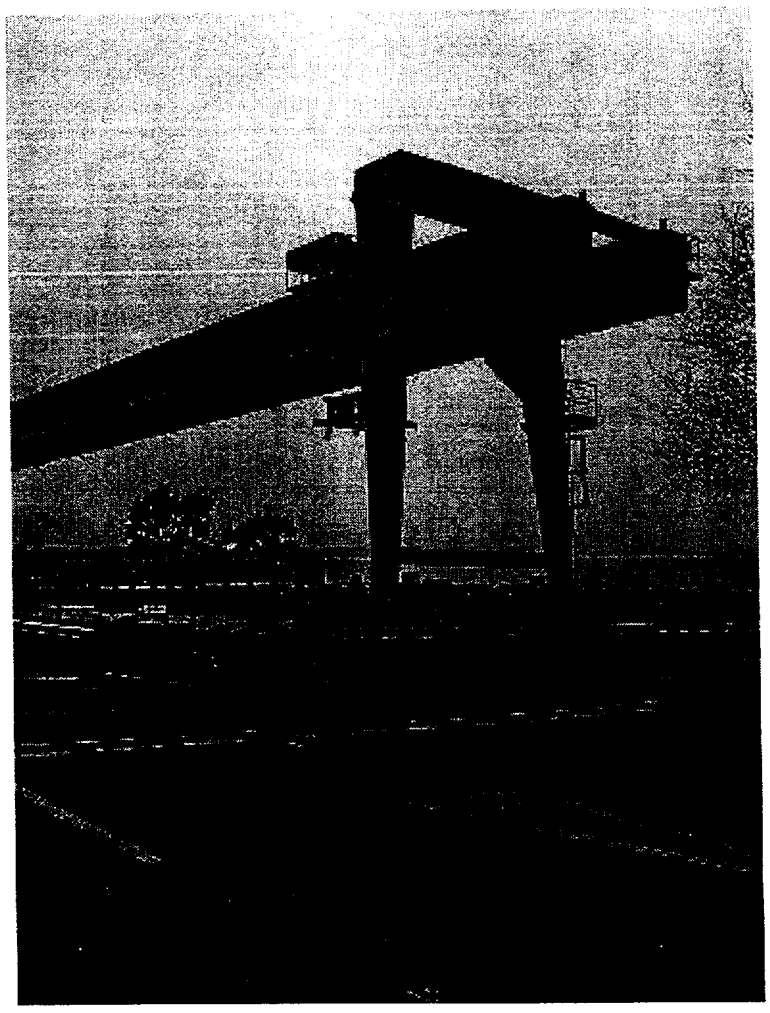
This building provides:

- Truck loading / off loading bays for 30 and 48 inch cylinders
- Cylinder pressure test bay
- Product cylinder storage
- Inventory weighing facility
- The building is provided with travelling crane coverage

LES

Pads

- Pad storage is provided for:
  - Buffer feed cylinder storage
  - Tails cylinder storage
- Pad travelling crane coverage is provided



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Blending and Transfer Facility

- This facility comprises electrically heated donor stations (capable of taking 48 or 30 inch cylinders) which are able to flow UF_6 to air chilled receiver stations containing 30 inch cylinders

- The process occurs at sub-atmospheric pressure

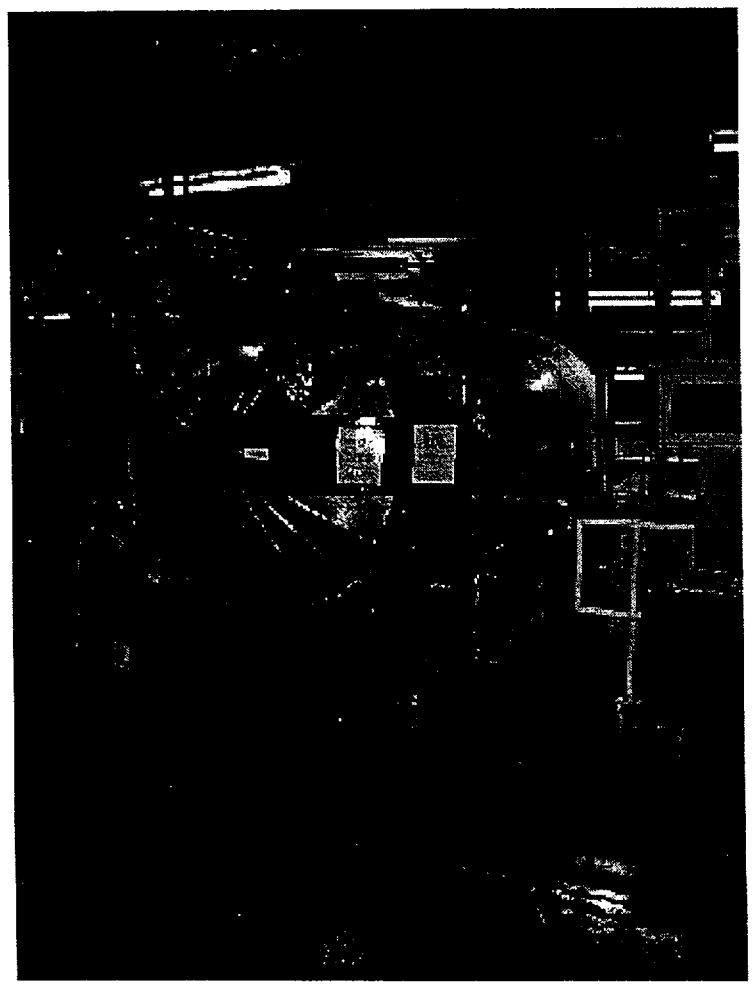
- The purpose of the facility is to enable customer product concentrations to be made up from stock materials

- The facility also provides the ability to transfer material from one cylinder to another (e.g. from a 48 inch to say six 30 inch cylinders) without necessarily blending

Liquid Sampling

- The Liquid Sampling Facility comprises electrically heated autoclaves which liquefy the contents of the 30 inch product cylinders

- The samples are drawn from the liquid phase, following which the autoclaves are cooled down



Supporting Infrastructure

The Technical Services required to support the operation and maintenance of the Enrichment Plant are as follows:

- Component Decontamination Facility
- Liquid Effluent Treatment Plant
- Contaminated Stripping Area
- Clean Build Area
- M E I & C Maintenance Workshops
- Laundry
- Pump Oil Recovery
- Residue Store
- Chemical Store
- Rad. Prot. Laboratory
- Chemical Laboratory
- Clean / Contaminated Change Room

* Some of these technical services may be available on the chosen site

Supporting Infrastructure

Centrifuge Assembly Building

- This building is provided to receive kits of components from Europe and assemble the kits into centrifuges for installation into the separation plant cascade halls

- Required during plant construction. No planned ongoing centrifuge maintenance or replacement

Administration Building

- This building provides accommodation for those personnel not accommodated in the separation plant, technical services or operational service areas

And finally, some facts and figures.....

- **Typically operation of a 3000000 SWU/yr enrichment facility will:**
  - **Require ~ 18 MVA electrical power (dual supply)**
  - **Require ~ 8,600 te UF6 Feed per year**
  - **Produce ~ 7,800 te DUF6 per year**
  - **Produce ~ 800 te UF6 enriched Product per year**
  - **Take delivery of ~ 700 full feed cylinders (48Y) per year**
  - **Dispatch ~ 350 product cylinders (30B) per year**
  - **Produce ~ 12 te / year LLW (unprocessed)**
  - **Consume ~ 6 std m^3 / min of Gaseous Nitrogen**
  - **Consume ~ 21 l / min of Liquid Nitrogen**

PRINCIPAL DIFFERENCES BETWEEN THE ORIGINAL LES ENRICHMENT PLANT AND THE CURRENTLY PROPOSED LES PLANT

LES

Key technical differences between the original LES plant (for simplicity call LES-1) and the plant now proposed for construction in the USA (for simplicity call LES-2) can be grouped into the following three main categories:

- Inherent site differences
- Separation plant differences
- Internal infrastructure (utility / support system) differences

SITE CHARACTERISTICS

- **Site has not yet been selected**
- **Site selection criteria broadly the same**
  - low seismology
  - land not previously contaminated
  - moderate climate
  - redundant good quality electrical supplies
- **One significant difference is that LES intends to construct the facility on an existing nuclear site**

SEPARATION PLANT DIFFERENCES

Overall Plant

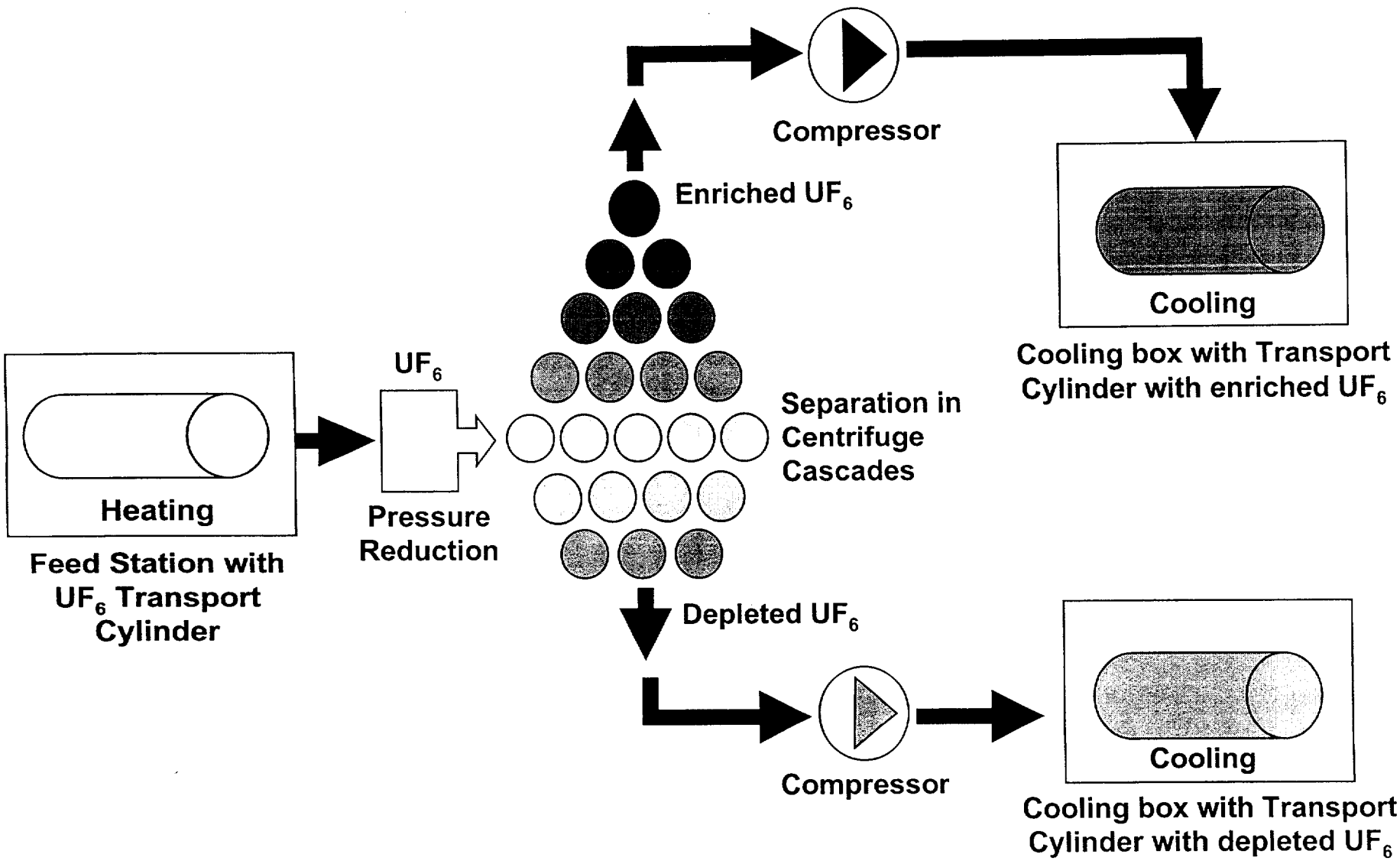
- Current LES-2 projected capacity is 3 million SWU/yr, while LES-1 was a nominal 1.5 million SWU/yr plant (6 modules @ 500,000 SWU/yr compared to 3 modules @ 500,000 SWU/yr)

- Urenco plants are currently designed to safely produce up to 6 % enrichment while the LES-I plant was designed for 5 %

- The blending and liquid sampling facilities were housed within the UF6 Building in LES-1 whereas in LES-2 the current proposal is to house them in a separate building

- Layout of plant will change to reflect the above, and site specific requirements

Flow of UF_6 through the Enrichment Plant



LES

FEED SYSTEM

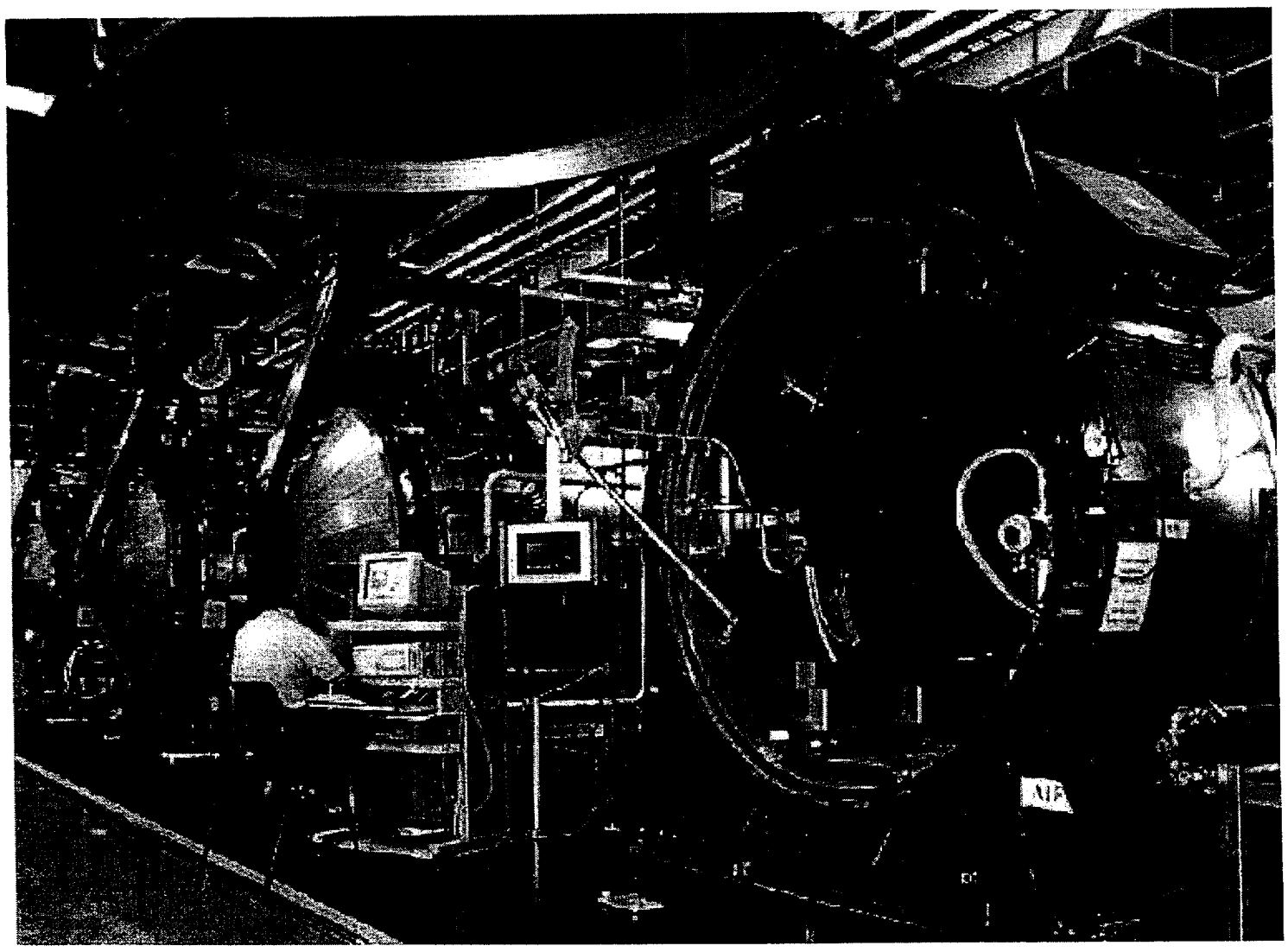
- **Urenco has now eliminated feeding from the liquid phase (using autoclaves) and now only feeds from the solid phase at sub-atmospheric pressures using feed stations.** ***This results in an inherently safer process.***

- **The capacity of the feed purification desublimer has been reduced from 500 kg down to approximately 50 kg and the maximum operating temperature has been reduced from 50°C down to ambient temperature.** ***This results in an inherently safer process.***

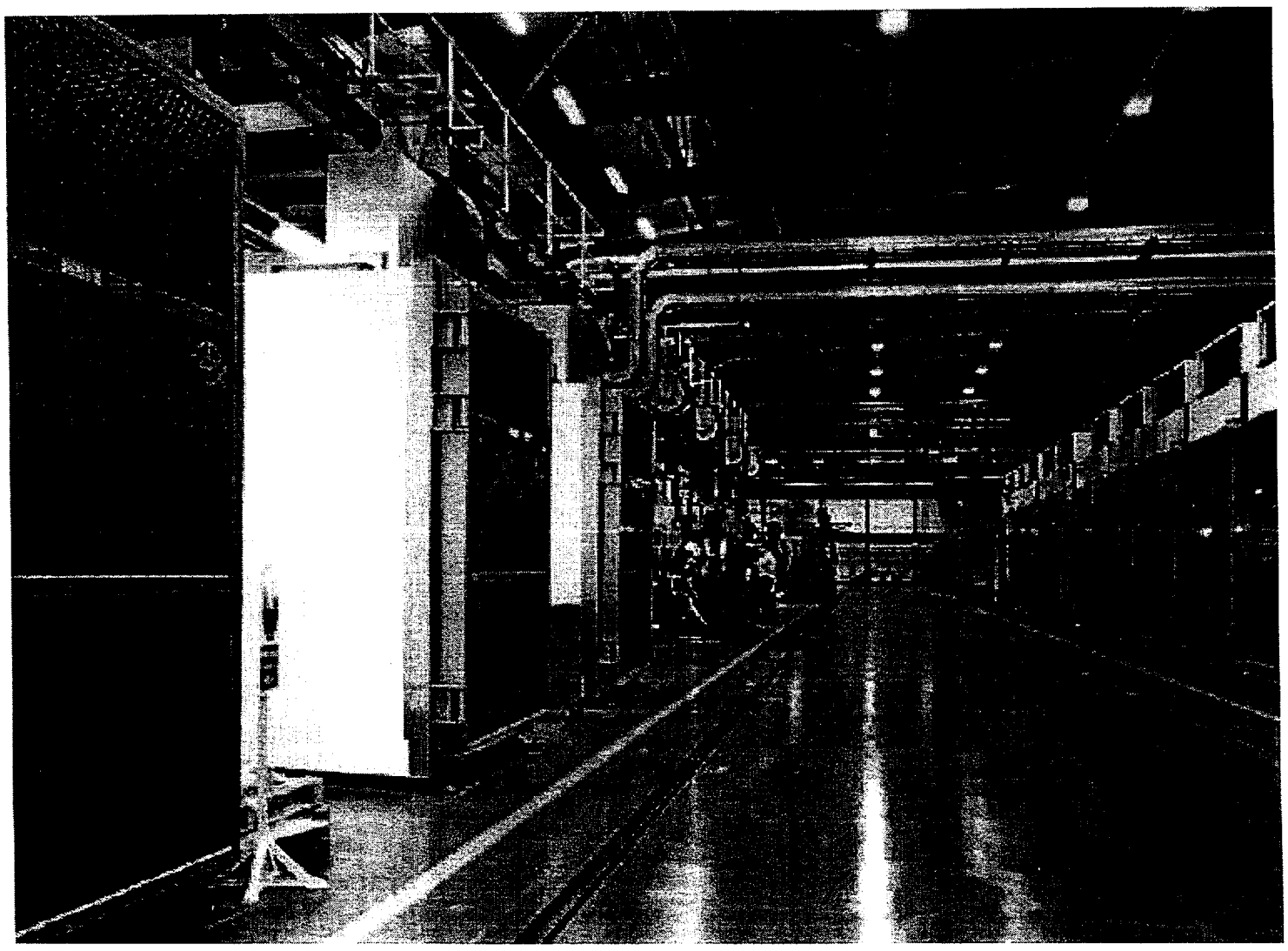
- **All Freons have been eliminated from the heating / cooling systems of the feed purification desublimers,** ***resulting in a more environmentally friendly system.***

- **The feed purification cylinder station now operates at – 25°C, rather than at 4°C as previously,** ***resulting in a more environmentally friendly system.***

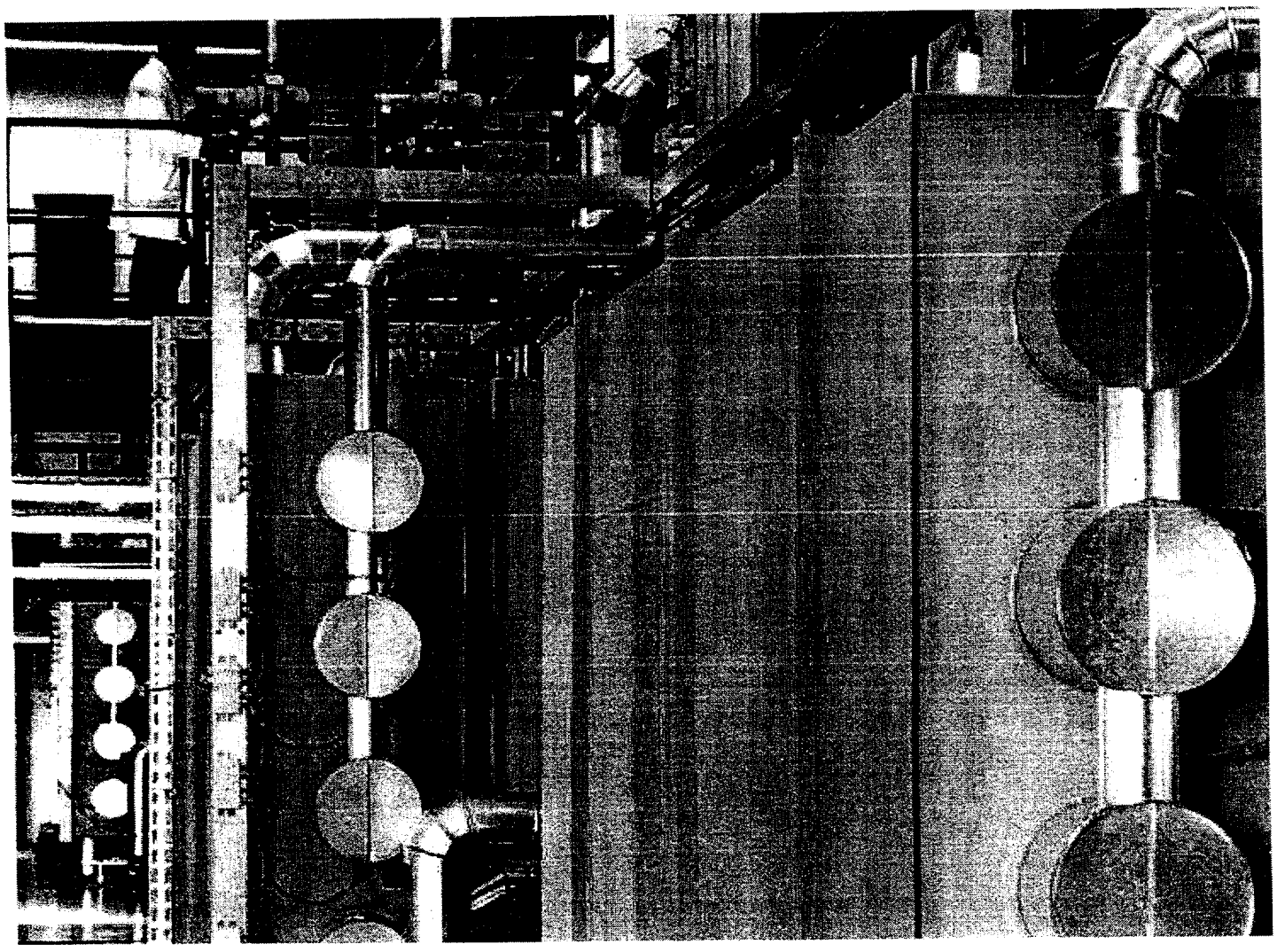
FEED AUTOCLAVE (LES-1)



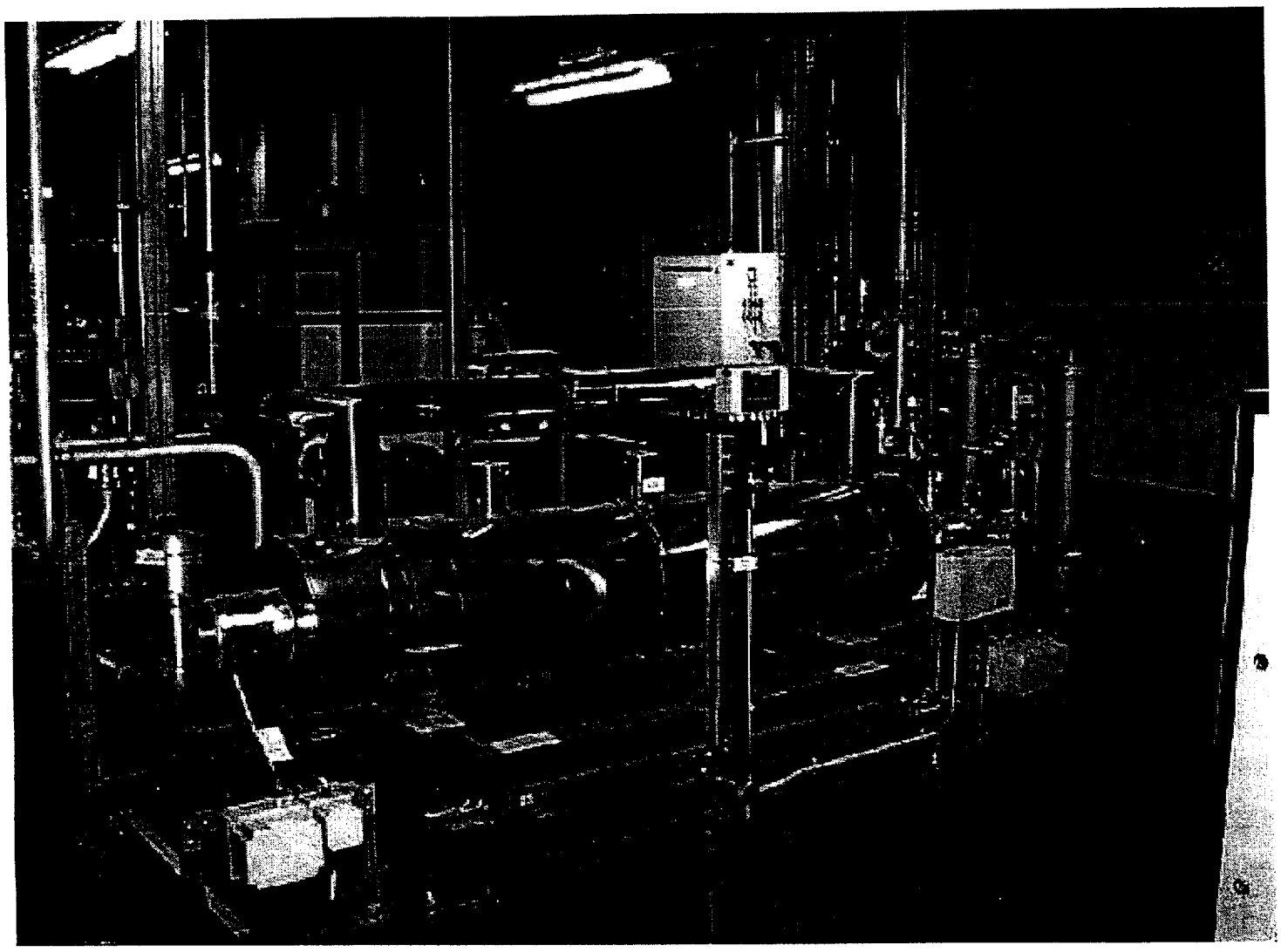
SOLID FEED STATION (LES-2)



FEED PURIFICATION DESUBLIMER (LES-1)



FEED PURIFICATION DESUBLIMER (LES-2)



CENTRIFUGES / CASCADES

- **Urenco will use the same centrifuge type in the LES-2 plant as envisaged for the LES-1 plant**
- **The number of machines per cascade will be somewhat greater in the LES-2 plant**
- **The number of cascades per module (assay unit) will reduce accordingly**

PRODUCT TAKE-OFF SYSTEM

- **Urenco has redesigned the product take-off system to dispense with the second stage of pumping. Take-off is now into cylinder stations cooled to –25°C. (The removal of second stage pumping eliminates the potential fault scenario of the second stage pumps discharging to atmosphere).** ***This improved design results in enhancement of safety and less impact on the environment.***

- **Cascades no longer have dedicated low pressure pumps, these pumps are provided on an assay basis, ie shared between cascades.** ***This results in fewer maintenance activities and thus lower worker dose.***

- **The product vent desublimer is identical to the feed purification desublimer, ie has been reduced in capacity and utilises no Freons. It is critically safe by geometry.** ***This improved design results in enhancement of safety and less impact on the environment.***

TAILS TAKE-OFF SYSTEM

- **Urenco has redesigned the tails take-off system to dispense with the second stage of pumping. Tails take-off is now into cylinder stations cooled to –25°C. *This new design results in enhancement of safety and less impact on the environment.***

CONTINGENCY DUMP SYSTEM

- **Essentially the same system as LES-1 but Urenco has added pumping capacity on a cascade rather than an assay basis**

GASEOUS EFFLUENT SYSTEM

- **Essentially the same system as LES-1**

SEPARATION PLANT SUMMARY

		ENHANCEMENTS	
System	**Feature**	**Safety**	**Environmental**
Feed	**Solid feed station**	✓	
	Smaller desublimer	✓	
	Lower temperature purification		✓
	Elimination of Freon		✓
Product	**Low temperature take-off + removal of 2nd stage pumps**	✓	✓
	Smaller desublimer	✓	
	Elimination of Freon		✓
Tails	**Low temperature take-off + removal of 2nd stage pumps**	✓	✓

INTERNAL INFRASTRUCTURE (UTILITY / SUPPORT SYSTEMS)

Internal infrastructure differences are site specific. Currently known key differences between LES-1 and LES-2 are as follows:

Utility / Support System	LES-2	Remarks
Criticality Accident Alarm System	European design available	Not required for LES-1
Plant Control System	Urenco plants incorporate state-of-the-art software control and (independent) protection systems	LES-1 technology obsolete
Blending Facility	LES-2 design utilises donor stations operating at sub-atmospheric pressures	LES-1 design autoclaves / super-atmospheric pressures obsolete
Refrigeration Systems	Plant does not incorporate any Freon systems	LES-1 systems obsolete
Oil Recovery System	Process as LES-1 but design considerably improved	Non-recoverable oil now eliminated from all UF_6 systems

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SUMMARY

SIGNIFICANT CHANGES

- ❑ Plant Capacity
- ❑ Design Enrichment Level
- ❑ Elimination of Feed and Blending Autoclaves with Significant Lowering of Process Pipework Pressures
- ❑ Elimination of Large Hold-up Desublimers and Freon Usage
- ❑ Elimination of 2nd Stage Pumps
- ❑ Introduction of Low Temperature Take–off Stations
- ❑ Introduction of State-of-the-Art Plant Control System

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General Approach to Licensing

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Interface/Organization

- **Licensee is Louisiana Energy Services (LES)**
- **US organization is being assembled**
- **Licensing interface through Rod Krich, Exelon Nuclear, on interim basis**

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Applicable Regulations and Guidance for Application

❑ Principal Regulations

- 10 CFR 40, "Domestic Licensing of Source Material"
- 10 CFR 70, "Domestic Licensing of Special Nuclear Material"

❑ Principal Guidance Documents

- Regulatory Guide 3.25, "Standard Format and Content of Safety Analysis Reports for Uranium Enrichment Facilities," December 1974
- NUREG - 1520, "Standard Review Plan for a License Application for a Fuel Cycle Facility," February 2002
- NUREG - 1513, "Integrated Safety Analysis Guidance Document," May 2001

Treatment of Unchanged Licensing Information

- Review existing Safety Analysis Report (SAR) through Revision 21
- Review NRC Safety Evaluation Report (SER) (NUREG-1491), January 1994
- Identify unchanged licensing basis information that has been accepted by the NRC
- LES to propose treatment of unchanged information

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Application Schedule

- ❑ **Pre-application review March - September 2002**
  - ■ **Submittal schedule (prior/after meetings)**
- ❑ **Advisory Committee on Reactor Safeguards (ACRS)**
- ❑ **Application submittal (SAR, Environmental Report) - 4th quarter 2002**
  - ■ **Electronic format**
  - ■ **Units**
- ❑ **Proposed NRC approval by 2nd or 3rd quarter 2004**

Future Issues and Topics for Pre-application Review

Proposed Prioritization of Meeting Topics and Schedule of Pre-application Review Meetings

Proposed Pre-Application Meeting Schedule and Prioritization

- ❑ **Mid-April**
  - ■ **Policy Issues (e.g., environmental review criteria)**
- ❑ **Mid-May**
  - ■ **Codes and Standards**
  - ■ **Security**
- ❑ **Mid-June**
  - ■ **Review and Handing of Restricted Information**
- ❑ **Mid-July**
  - ■ **Plant Control Systems**
  - ■ **Conduct of Operations - transfer of operating experience**

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Proposed Pre-Application Meeting Schedule and Prioritization, cont'd

- **Mid-August**
  - **Site Characterization**
  - **Quality Assurance Program/Classification of Structures, Systems, and Components**

Wrap Up - 1

- Urenco has a proven technology and a successful history of plant construction
- The project has US utility and industry backing
- The lessons learned from the LES project provide an excellent starting point

Wrap Up - 2

- LES is providing the following:
  - A well proven and efficient enrichment technique
  - Plant design based on proven safety case, operating in Europe
  - Incorporating provisions for decommissioning and mid term UF_6 tails storage

- LES is asking for:
  - Assured short and predictable licensing process
  - Access to US disposal route